# ORANGE CULTURE IN CALIFORNIA

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# ORANGE CULTURE

IN

# CALIFORNIA.

BY

THOS. A. GAREY.

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WITH AN

## APPENDIX ON GRAPE CULTURE

BY

L. J. ROSE.

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PUBLISHED

FOR A. T. GAREY.

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# PREFACE.

For a number of years I have thought of putting my extensive practical experience in citrus culture into book form, and now, at the earnest request of numerous friends, I shall, for the benefit of those who are seeking information in semi-tropical fruit culture, proceed to carry my purpose into effect, hoping that this will be a profitable guide to this most interesting and remunerative industry.

A residence of twenty-eight years in this State, the last sixteen of which have been devoted exclusively and uninterruptedly to semi-tropical orcharding and nursery business, enables me to write from a practical standpoint possessed by few. A lover by nature of the beautiful in horticulture, I have applied myself assiduously to assist in developing the latent interests of the business of citrus culture, by endeavoring to procure the best of the different species, by propagating and experimenting on a large scale, and carefully noting the different varieties. The field has been and still is wide and ample. However much I may have learned, I feel that we are only on the threshold of learning what are the most successful conditions for the profitable citrus culture of the future.

I shall endeavor to present the subject in as brief a form as possible consistent with the many ramifications of the business, using no technical phrases, the object being to adapt the work to the understanding of all that may at any time be engaged in the business.

It is important that all that venture in this business start right. This book is written to enable them to avoid many of the sunken rocks on which hundreds have been wrecked. I do not purpose to present myself vainly and egotistically to the public as one who has learned all there is to know about citrus culture, but as one who is willing to give his long and practical experience conscientiously.

I believe there is yet much to be learned on this subject, and that this may the more speedily be done, I record my views, believing that by comparing them with the experience of others the object may be sooner attained.

It was my intention to write a chapter on the history of orange culture in Southern California, but the want of reliable historical data does not justify the attempt.

Hopeful that this work will fill a niche unoccupied at present, and that it will result very beneficially to this advancing branch of horticulture, I humbly dedicate it to all lovers of the beautiful in nature, and especially to all lovers of this health-giving, profitable industry.

THE AUTHOR.

LOS ANGELES, Cal., April, 1880.

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# CHAPTER I.

## Introductory Remarks on Orange Raising.

That the culture of the citrus family of fruits is destined to become one of the leading industries of the great State of California is no longer disputed by the intelligent, reflective, progressive mind. That it is now, and will continue to be, one of the principal incentives to immigration into this State, is an acknowledged fact, which is amply proven by the testimony of all that have taken the trouble to inform themselves on the subject.

We may write and talk to our Eastern brethren about our great resources, and our ability to compete with any part of the world in the production of wheat, barley, corn, vegetables, fruits of all kinds, wool, wine and other productions; but, under the most favorable circumstances, only a partial attention can be secured, till the culture of the orange is mentioned, and the beauties of our orange groves portrayed and described in all their luxuriance and magnificence, and their profits set forth; then the ear and the attention of the investigator are fully gained. An individual or an audience never tires of listening to the history of our peerless groves of golden apples—the handsome, symmetrical, electrifying Golden Glory of the Pacific slope.

How grand, how beautiful is an orange orchard in full bearing! When planted artistically, their ever-enduring dark-green foliage, studded with beautiful gems of golden spheres, give renewed life and health to all that behold the orchards or partake of the fruit. Those who are so fortunate as to tread the soil in the shade of the majestic trees, and breathe their fragrant exhalations, look upward, and from their most interior selfhood

they thank the Great Author of the grand, useful and beautiful in nature for so sublime a manifestation of His works, and His good gifts to mortals. There is inspiration, as well as beauty and princely profits, in an orange orchard. When tourists are examining our prolific fields of grain, our orchards of superior temperate-climate fruits, and our varied general productions, they are filled with wonder and admiration by our extraordinary possibilities, and our success in all the multifarious departments of agriculture and horticulture. But our orange groves only can call forth the full exclamations of wondrous excitement from our brothers and sisters from the frozen regions beyond the mountains, and these groves dilated upon, and their praises sung, are long remembered after all other scenes have been forgotten. Then let us magnify our great opportunities by planting more orange trees; let us increase this soul-inspiring, profitable industry, thereby leaving to our children a legacy that will cause us to be remembered with honor, and that will be a blessing to future generations. In order to do this, let us endeavor to start right, lest we be disappointed. I now purpose, as a warning voice, to consider the responsibilities usual in orange culture, that success may crown our efforts with a golden and substantial reward.

The founding of an orange orchard is not all poetry and romance; the stern, cold facts and responsibilities of the industry soon become apparent. The investment of money, time, labor, patience and perseverance required to plant an orange orchard and conduct it to a bearing and self-sustaining condition, is of more magnitude, notwithstanding all our advantages, than beginners generally imagine it to be. Many who are not apprised at the start of what they have to contend with, get into debt and become discouraged, and the only apparent avenue of escape is a mortgage on their orchard. This is generally the first step to ruin, and it often results in the loss of the entire investment. Few succeed in redeeming their property from an encumbrance of this kind. The orchard begins to fruit in a few years, but, alas! too late for the over-sanguine owner, and the end is usually reached in a summary manner through the courts, assisted by the sheriff.

It is well to know at the threshold of the enterprise, that to plant, cultivate and bring an orange orchard to a remunerative condition requires money, determination and close application, and years of time and labor, to carry us safely through all the vicissitudes and disappointments continually encountered in orange raising. I do not make these statements for the purpose of discouraging the extension of our citrus interests, but in all kindness, as a warning to the uninitiated, and, perhaps, to the over-zealous of our people. We are prone to be in too much of a hurry, and to go too fast for our ultimate good.

However strong may be my belief and faith in the grand profits destined to be realized from this industry, my advice is, be careful in your estimates, and do not go beyond your means. Be not too hasty to get rich in this branch of horticulture; be sure of your ability to carry to a successful termination the load you start with. It will be better to add a little from time to time, during your progress, than to break down by overloading, and never arrive at the promised land. Numbers among us have been wrecked on the hopeless beach of despair in their efforts to rush, without probation, to the realization of their golden dreams. Then, beware of quicksands, and ford the river at a safe place. Let all, then, proceed patiently to peruse the following pages, and put in practice the information gained—information that has cost the author years of time—and if they then engage in this business they may reasonably hope for a golden reward.

I neither profess perfection nor aspire to it in the department of horticulture. As time rolls on, and orange culture shall have become more systematized, I sincerely believe that much knowledge superior to mine, and more practical than what may be found in these pages, will be garnered and assimilated; but I believe that this (perhaps the latest attainable at present) will be endured.

On this foundation let us work to build a grand superstructure. Those who profit from the hints in the preceding will surely be benefited, and will certainly succeed.

# CHAPTER II.

## Selection of Seed, and How to Raise the Plants.

The foundation of a successful orange grove is the stock from which it is grown. If the stock be diseased, or stunted in growth from any cause, ceaseless vexations will be the legitimate result. The first requisite is the seed and its selection. This part of the subject belongs properly to the nursery department; it may prove valuable to beginners, and may be of use to those who have been long in the business.

The seed should be selected from large, well-formed, fine-flavored, ripe fruit, particularly if the trees be intended to fruit as seedlings; and, even if the trees be budded or grafted, the origin of the stock is of first importance. A poor, shrunken, immature seed never produces a first-class plant. Having procured the fruit, take the seed out carefully, and partially dry it in the shade, but never allow an orange seed to become *dry*, as very few such seeds, if any, will germinate.

Prepare your seed-beds for convenience with reference to future care, by making them from three to five feet wide, and leaving a pathway about two feet wide between them, exclusive of a foot for borders on each side of the bed, thus admitting of weeding from either side to the center of the bed. This is important, as there will be weeds to contend with, which must be plucked up with the fingers. There should be a slightly raised border on each side of the bed. To prepare the bed for the seed, pulverize the soil deep and thoroughly, and finish with a hand-rake, making the bed level. Sow the seed in drills, an inch or two apart in the drills, or sow broadcast, using judgment in so doing not to sow too thick. The number of plants to a square foot ought not to exceed fifty. The number of

plants that can be raised from a barrel of rotten oranges varies from 3,000 to 8,000, depending in part on the size of the barrel and the quality of the seed. The seed of the Tahiti orange is much better than the seed of the Los Angeles. Rotten Tahiti oranges can be had in San Francisco for several months, commencing with April, at from two to five dollars per barrel, according to the demand. A sieve with quarter-inch mesh, a coarse, stiff brush, and plenty of water, are the necessary requisites for washing out large quantities of seed.

Having sown the seed, roll with a light hand-roller, which will press the seed into the mellow soil level with the surface, and leave the bed quite smooth. A spade or a piece of board may be used instead of a roller. Cover lightly with good soil. If the soil in which the seeds have been imbedded be not naturally mellow, a top dressing of some sandy loam, from one-fourth to one-half of an inch in thickness, will answer. The ground must be moist and in good order at the time of sowing the seed. Never sow or plant in a dry soil, or when it is wet and mucky. The seed-bed must be watered with care after the seed shall have been planted; the ground must be kept moist, but not wet; the surface must not be allowed to become dry.

Preparations must now be made for protecting the young plants from the direct rays of the sun. This can be done best by driving stakes one by two inches in size and three feet long, about six feet apart, in the borders of the beds, driving them from one foot to eighteen inches into the ground. Nail lengthwise to the tops of the stakes, one by one and a half or two-inch stuff. Good bailing rope can be used instead of the strips. Cover the beds by stretching over them and fastening to the strips or rope what is known as house-lining — a thin, gauzy cotton cloth, one yard wide. If the beds be more than three feet wide, stakes about three and a half feet long, and the same size as the above, may be driven in the center of the bed and strips nailed to their tops, lengthwise of the beds, or bailing rope may be fastened to the stakes. If the cover be level, it should be from sixteen to twenty-four inches above the beds, the height depending on the temperature of the locality in which the beds are made; if raised in the center about a foot on the

sides and two feet in the center. I think strips one and a half inches wide are as good as wider ones, though I have used them wider; or plasterers' six-foot laths can be economically used. The cloth admits sufficient light and heat to cause the seed to germinate and the plants to grow rapidly, while it protects them from injury from the heat of the sun.

The embryo trees appear in from four to six weeks from the time of planting the seed. The ground in the seed-beds must, in the meantime, be kept scrupulously free from weeds. After the plants come up nothing remains to be done but to give them general care and culture, with water sufficient to keep the ground moist, as mentioned, until the irrigating season be over.

As soon as the plants shall have attained a hight of two or three inches they will be hardy enough to withstand the direct rays of the run; the cover may then be removed. It should be put back on the approach of cold weather and remain over the beds till the following spring, as a protection against frosts. Well-grown plants usually attain a hight of about one foot the first season..

The best time at which to plant the seed is from April to June. Never plant when the ground is cold, if it can be avoided. Never use thin, poor land under any circumstances; the soil must be rich.

# CHAPTER III.

## Selection of a Site for a Nursery.

Too much care cannot be exercised in the selection of a site for a nursery. The quality of the soil is of the first importance; it should be a deep and rich sandy loam mixed somewhat with clay. A soil of this character is naturally warm and retentive of moisture, and the roots of the young plants permeate it without difficulty.

It is important to avoid hard-pan or cement near the surface, as it cuts off the under drainage, and the roots suffer from excessive dampness and cold. A southerly exposure is best. The location should be protected as much as possible from winds, and care should be taken to locate where frosts are not severe. A nursery liable to be frost-bitten annually is annoying and damaging to the owner. Trees severely frosted make a stunted growth, rarely outgrown, if ever.

An abundant supply of water for irrigation is the most important of all; for without an abundant supply of water all other advantages will be neutralized. With the foregoing precautions and plenty of water healthy, handsome and thrifty trees may be produced.

Young orange trees in the nursery require and must have an abundant supply of water during all the summer months, to insure a perfect and satisfactory growth. When all of the foregoing points shall have been carefully observed, the nurseryman may, with proper after-management, confidently expect to be able to supply his customers with trees that will give satisfaction, and to lay a foundation on which he will soon be able to build a reputation that will be a lasting source of pride and profit to himself and his customers.

# CHAPTER IV.

## Transplanting to the Nursery.

When the young trees have completed their first year's growth they should be transplanted to the nursery. April and May are generally considered the best months in which to transplant the young trees, the latter month being thought by many the best of all the year, for the reasons that the ground is then sufficiently warm, and that this month is more or less cloudy or foggy here (in Los Angeles) and comparatively free from cold winds.

The preparing and laying out of a piece of ground for a nursery should be properly done. A little extra work at this time will be well repaid in the future. The rows should run north and south, to expose the whole surface of the ground to the full force of the sun's rays during a great portion of the day. The rows should be four feet apart, and the trees a foot apart in the rows. The ground should be in the best possible condition; if to be irrigated subsequently, it will well repay the outlay of time and labor to make it as nearly even as it can conveniently be made, by irrigating before planting, cultivating again before planting, and leveling all uneven places, that the irrigating may thereafter be comparatively a pleasure. If the work be carelessly and hurriedly done it will be a source of annoyance and vexation for a long time—sometimes during the entire existence of the nursery.

After having prepared the ground for spacing and laying out, it should be laid out in convenient sections for removing the trees. The length of the rows should never exceed three hundred feet, at each end of which, and running at right angles to them, there should be a space of about fifteen feet to admit the

passage of a team and wagon, and for convenience in turning when cultivating. Provide a strong rope, cord or wire, a few feet longer than you wish the rows to be; a four-foot measure at each end of the section, with which to mark off the distances between the rows; two good hard-wood stakes, or iron pins, which are better, and tools with which to drive them firmly into the ground. Fasten one end of the rope (cord or wire) to a stake driven at one end of a proposed row, and having drawn it tightly, fasten firmly to a stake driven at the opposite end of the proposed row. Straighten it if necessary. For marking the spaces in the row use a tool made similar to a hand-roller, with triangular pieces a few inches long fastened lengthwise to the roller and a foot apart. Four feet in circumference, or a small fraction more than fifteen and one-fourth inches in diameter, is a convenient size for the roller. To use this tool, take hold of the handles, place the roller on the tightly-stretched line and push it forward or draw it after you along the line; the pieces on the roller will mark crosswise of the line at regular distances of a foot. If any other distance be desired, it can be regulated by the diameter of the roller and the distance between the strips. Remove the line to the next proposed row. This leaves a mark lengthwise crossed at regular distances, ready to receive the plants. A roller of a greater diameter would require less power to use it.

I have been particular in describing this method of planting—a method on which I believe there is no patent—as it will save the nurseryman much time and trouble, besides enabling him to make the rows of trees as nearly accurate as possible. It will soon be appreciated in the ease with which the trees can be cultivated. A straight row of trees can be cultivated more easily than a crooked row. The distance of four feet between the rows admits of cultivating with a horse-hoe or a cultivator, and the distance of a foot between the plants admits of thorough hoeing with a hoe of good size.

Now, having the ground ready for the plants, remove from the seed-bed not more at one time than can be handled and planted before the tender plants will suffer from unavoidable exposure. The seed-bed should be soaked by irrigation to the

depth of not less than nine inches, from one to four days before transplanting, the length of time depending on the nature of the soil. It is preferable to have the plants growing at the time of their removal. Never remove the plants, under any circumstances, from a hard, dry soil. A common short-handled spade is the best to loosen plants with. Press the blade perpendicularly into the ground and draw it backwards and forwards to loosen the plants. Immediately after pulling the plants put them in the shade, never exposing them unnecessarily to sunshine or wind. Sort them after having pulled a few hundred, or at the most a thousand or two, making three grades. Prune the roots and tops, leaving about six inches in length of each. Dip the roots into a bucket of soil wet to a proper consistency with water; this process is called *puddling*. This coats the roots of the plants with soil, which adheres to them and prevents damage from necessary exposure. This wet mud, known among nurserymen as *grout*, should be composed of rich soil of a sandy nature, with a very small portion of clay to make it adhesive. The plants are frequently puddled before sorting, and the sorting done at leisure. This is not usually done unless the plants are to be moved a long distance, and even then it is not always done. The sorting can be done more expeditiously before puddling. Set the plants in small boxes about a foot in depth. If it be desired to set only first-class plants, the smaller can advantageously remain another year in the seed-bed; but when removing all the plants, all inferior ones should be rejected; and even if allowed to remain another year before transplanting they will not be so good as the larger plants. A poor, dwarfed plant makes, as a rule, a poor, dwarfed tree, and it is best to destroy such plants. Take the plants to the nursery and place them in boxes of convenient size for the laborers, each of whom should take a box of plants, and, getting down on his knees (if he has never been on his knees before this will be a good time for initiating him), he should set the box at a convenient distance before him. He should take a plant in the left hand, and with the right place the point of a nurseryman's dibble at the intersection of the cross made by the line and the implement used for marking. Press the tool down the whole

length of the blade, pressing backwards and forwards. This will make a hole sufficiently large to receive the roots of the plants without doubling or cramping them. Withdraw the tool and at once insert the roots of the plant, placing them about an inch deeper than they were in the seed-bed. Place the dibble an inch or two in front of the plant and press the soil firmly against the root, being careful to leave no vacuum at the lower end of the roots.

After the plants are set they should be thoroughly watered; flood the ground if practicable. When the ground is in proper condition, cultivate close to the plants, so as to loosen the entire surface of the soil. The future cultivation will consist in keeping the soil moist, free from weeds and well stirred.

The plants should not be pruned the first year after setting. Let them grow bushy and stocky; this will develop a mass of fibrous roots. Pruning should commence the next spring and summer. Prune off the surplus branches, leaving the best branch or *leader* to form the stock for the future tree. From time to time, after the first pruning, thumb-prune the young shoots that come out low down on the stock, keeping one or two feet clear of limbs. Prune off a foot or two more of the lower limbs the next year; the trees will then have a stock or body from three to four feet to the limbs. The trees will then be ready for market, but they will still require constant culture and attention to keep them vigorous and healthy.

# CHAPTER V.

## Selection of Site for an Orange Orchard.

As the selection of a site for a nursery is of the first importance, so it is, but in a greater degree, in the selection of a site for an orchard. A suitable locality is the first requisite, for not all places in semi-tropical California are fully adapted, if adapted at all, to the full development of the trees and fruit. The table or mesa lands near the mountains have been proven to be the best localities for the production of the finest and best-flavored oranges. Though the flavor of the fruit in the valley or near the sea, where dense fogs prevail, may be good, the fruit is generally partially or wholly covered with a thick coat of black fungus mold, rendering it unfit for market and comparatively unmerchantable. This black mold or rust adheres firmly, not only to the fruit, but the limbs and leaves are disfigured with it. On the high table lands, especially those that are not subject to heavy fogs, trees that have been grown on low lands and that are covered with this mold will soon become clean and bright. These elevated lands are generally free from heavy frosts. The degree of cold is much greater on the low valley lands. The soil should be a deep sandy or gravelly loam, with an admixture of clay and a gravelly sub-stratum, free from hard-pan; at all events the hard-pan should not be less than six feet from the surface; but a soil with no hard-pan is preferable.

A place free from strong winds is best, but some that are subject to them are otherwise exceedingly desirable. Some windy places have been proven to be the best in other respects for orange culture. If orchards be planted in places subject to wind, wind-breaks should be planted at once.

A plentiful and reliable supply of water must be available,

for the future success of the orchard depends on a bountiful supply of water. My advice to all is, be sure you have an ample supply of water where you locate your orchard, for, in my opinion, the full measure of success can never be obtained without it. If you succeed by thorough tillage, without water, you will deserve to be envied; but ample irrigating facilities will be safe precautions, and will operate as an insurance policy against unusual drought.

I predict that the future orange orchards, famed for the beauty and quality of their fruit, will be found on our high, dry mesa lands, and that the product of the orchards of the valleys and low lands will find a second place in the orange marts of the world; hence take warning and start right by making a careful selection of a site on which to plant your orange grove.

In connection with this subject I append extracts from a discussion on the "Adaptability of Fruit Trees to the Soils," which took place before the Southern California Horticultural Society, at its April session, 1878. Dr. Congar made the following opening remarks, in substance:

The importance of adaptability of soil to tree and plant life was little understood. The propagation of fruit trees so as to insure them the best possible conditions was a most difficult undertaking. The soil must, of course, receive our first consideration; for to that alone in condition the seed and plant owe their sustenance. Too much stress has no doubt been laid upon the function of the leaf to supply the future tree in its unfoldment with the elements—oxygen, carbon and nitrogen. All of these elements, and also others entering into tree structure, are undoubtedly carried up from the soils in a greater or less degree as nutriment. The sodas, potashes, magnesias, irons, acids, etc., found in tree substance are gathered up by the roots, and are composed largely of oxygen and carbon; therefore it is but fair to conclude that these two most important elements contributing to the growth are not wholly absorbed by the leaves of the tree or plant. Observation has led him to study his soil closely, for he has found great variation within a comparatively small area. Even within a few square rods marked differences will manifest themselves in the vigor and general

appearance of the trees. Close investigation has demonstrated that the orange and the lemon tree, in particular, are very sensitive to their soil surroundings. If an orange tree is growing, for instance, in a warm, rich, friable soil, that is well underdrained and that will not toughen by continued rain or by artificial irrigation, its vigor and healthy appearance are marked in great contrast to those of its associates but a few rods distant which may be struggling in a cold, clayey soil, both receiving the same surface care and treatment in the meantime.

This question has received and is still receiving the closest attention that science and skill can bestow upon it in the Old World. But it is, if possible, more important to us of Southern California, especially those of us who are endeavoring to put into the soil trees that inherit a vigor and tendency to outlive a thousand generations. To reduce this to a practical proposition, will it *pay* to risk the citrus family in any soils but those which *already* give evidence of adaptability to their natural demands? The pear, plum and apple, at least, thrive better in the colder and stiffer soils, and will *they* not pay? The question may arise in the minds of some, why is it that there is so great a difference between the clayey and the sandy soils in their effect on the growth of the trees already mentioned? It is quite clear to my mind, from the fact that the one family requires continued heat and moisture, and especially the heat, to such a degree beyond the wants and necessities of the other. If you expose, for instance, a given quantity of clayey loam under test conditions to a moist atmosphere for a given time, it will absorb about one-quarter more water than the same quantity of sandy loam under the same conditions, and seventy-five per cent. more than a calcareous sand. Pure clay will absorb still more than clayey loam. Now why is it that clayey soil is so objectionable, particularly in our warm and dry climate, if it can absorb and retain so much more moisture than the sandy and friable soils? Simply because in giving off this water it carries away the heat so absolutely essential to the well-being of the citrus family. If, for instance, only sufficient water were applied to supply the needs of the orange tree, and the soil in which it grew could be kept in a friable condition by mechanical means,

much of the objection to the clayey soil would be removed; but, unfortunately, here lies the difficulty. Another objection is, that a soil so tenacious of water excludes the air in a great degree. Probably few have failed to observe the great difference in the facility with which soils part with their moisture. The sandy soils give it up most readily, of course, while the heavy or clayey soils are most obstinate. As he had no land for sale, and was not interested in any real estate agency, he thought he would be permitted to observe, in this connection, that the reason of the thrifty appearance of the trees and the vegetation generally on the sandy loams of Pasadena is owing solely, no doubt, to the great depth of those soils without hard-pan or clayey subsoils. Similar results may be anticipated throughout all dry countries wherever nature's dynamics have given us such a geological formation — one that allows all the rain to percolate to an unknown depth, to be restored again to the surface during the heated season by capillary attraction. The clayey soils are unquestionably the richest soils we have in vegetable matter — a very essential constituent. But its presence is not sufficient to insure success to the cultivation of the citrus family for the reasons already given.

To a question relative to orange trees near Anaheim, situated as they are in an alkali soil, with water within five or six feet of the surface, Dr. Congar replied:

"Orange trees in so close proximity to water would of necessity sustain themselves from a superabundance of surface roots, as it would not be possible for radical roots to exist. It would be impossible to decide as to their future, the presumption being that they would not reach a very great age, although productive for a time of a class of fruit inferior in keeping qualities and fine, delicate flavor. The quantity of alkali in the soil, as well as its character, would be an important factor in determining its effect upon the tree and its fruit." He alluded to the early fruiting tendency of unforced orange trees, and strongly favored this method rather than the forced method generally practiced.

Mr. T. A. Garey, the author, found that trees on land where the hard-pan lay only from a foot to eighteen inches from the surface were inclined to fruit early. The trees appear to do

well for a few years, but when the limited amount of soil is filled with roots, the trees receive a check in growth, and fruit is the result. Trees that are stunted or bark-bound, or trees the growth of which is checked from any cause whatever, will show a tendency to early fruiting. Trees of vigorous growth spend their energies in making wood instead of fruit. Budded trees fruit earlier than seedlings, and some varieties of budded trees fruit earlier than other varieties; but even with budded trees the more vigorous the growth the less liable are the trees to fruit early. He wanted deep soil for orange, with hard-pan from four to six feet below the surface. A thin soil is preferable for peaches. Adobe soil is best for pears. Apples require a soil more friable than the adobe; they ought not to be planted on a sandy soil. It is very frequently the case that many kinds of soil can be found on a small tract of land. On such a place an intelligent orchardist will study his soils and plant his orchard accordingly.

Isaac Kinley thought success depended largely on the mechanical conditions of the soil. Some soils contain ingredients that would prove poisonous to certain plants, and such combinations should, of course, be avoided; but much depends upon the mechanical condition of the land. Some soils left uncultivated bake hard; the same soils remain friable if properly cultivated, and are in condition to furnish plant food readily. A ball of packed clay will dry and bake as hard as a brick, while the same quality of clay will retain moisture if properly loosened up. A soil pulverized on the surface is protected from baking; the cultivation acts like a mulch. He thought adobe soil was not objectionable to orange growth so much on account of its chemical analysis as upon its close compactness. Anything that arrests the growth of the tree tends to develop fruit buds instead of leaf buds. This is why stunted orange trees in nursery put forth fruit buds. A diseased tree will also fruit.

Gen. Shields, of Florence, thought adobe soil should be loosened; it is richly supplied with plant food, but if improperly cultivated, yields it up with difficulty. He had improved adobe soil by scraping sand upon it, and *vice versa*.

Mr. Shorb said, in substance: "The subject under discussion

is the most important one that has been presented to the Society for their consideration. It should have been the first question submitted for discussion, for the whole science of agriculture and horticulture rests upon the proper comprehension of this fundamental principle."

Liebig says: "There is no profession which can be compared in importance with that of agriculture, for to it belongs the production of food for man and animals; on it depends the welfare and developments of the whole human species, the riches of States, and all commerce."

There is no other profession in which the application of correct principles is productive of more beneficial effects or of greater and more decided influence.

The *general* object of agriculture is to produce, in the most advantageous manner, certain qualities, or a maximum size in certain parts or organs of particular plants. The *special* objects of agriculture are to secure an abnormal development and production of certain parts of plants or of certain vegetable matters which are employed as food for man and animals and for the purpose of industry.

The mechanical organization and chemical constituents of soils, the particular kinds of soils required for the different orders of trees, and an absolute knowledge of the elements they feed on, are the great vital questions to be determined--questions upon which the success or failure of agriculturists and horticulturists depends.

The condition of development of every part of a plant depends on the amount and nature of the food afforded it by the soil on which it grows. A tree can be developed on the most sterile soil as well as on the richest, the only difference being in its hight, branches, blossoms and fruit. The rules of a rational system of agriculture should therefore enable us to give each plant what it requires for the attainment of the object in view. To accomplish this we must call to our aid the knowledge of the physiologist and the agricultural chemist for a solution of these questions.

Nature has, in her great wisdom, given to man a countless number of soils, differing in mechanical construction, and qual-

itive and quantitive chemical ingredients so organized and arranged that any soil product required by man in his civilized state may be furnished him.

In her native forests there are eloquent lessons taught by nature, and in the absence of scientific facts at hand we should at least study well these lessons to guide us in our labors. Every boy knows that in our Eastern forests the white oak is not found side by side with its twin brother, the pine or swamp oak; nor would he be likely to hunt in the pine forests for the shell-bark hickory, chestnut or hazelnut. This fact shows knowledge gained by experience, even with a boy; should not man, with his natural reason and judgment, ask himself why these phenomenal conditions exist, and endeavor to solve the problem?

Should not these natural forest growths teach him there is something more than accident there, that causes the pine tree to flourish when the oak will remain dwarfed and gnarled for an indefinite period, while it becomes, if properly located, the finest tree of the forest? Following this general line of thought and suggestions, should he not, as an intelligent and reasonable being, stop and consider that the tree he plants for the production of fruit for the maintenance of himself and his family is subjected as much to the same general laws and conditions as the native trees of the forest; and, realizing this truth, should he not use every means of discovering the growing principles of these general laws and apply them intelligently to the accomplishment of his ends?

In an article written in 1876 for the Chamber of Commerce of Los Angeles, confining myself to the citrus family, I thus wrote: "Orange, lemon and lime trees flourish and thrive well on a great variety of soils; but a deep, light, gravelly loam seems best adapted for the production of large and well-flavored fruits and the continued health of the trees. On soils of an argillaceous character, of moderate depth to the hard-pan, the trees do not preserve so vigorous a condition or produce so bright and sweet fruit as on the loamy soils, nor do I think they would attain the great age they have been known to attain in this country and in parts of Europe."

With the light of experience gained in the past few years I am convinced that I was then right, and that my opinion was founded on sound principles.

We have on our own property nearly all the varieties of soils, except the alkaline, that are found in the San Gabriel Valley. Orange and lemon orchards have been established upon the different kinds of soil. Some of the trees have stood twenty years, and a few are more than forty years old. Here, then, a good opportunity is afforded to study the adaptability of the soils to the wants and requirements of the citrus family. An orchard planted more than eighteen years ago is now standing on soils of a gravelly loam character. With no superiority of cultivation, these trees are healthy—not one diseased tree among four hundred and fifty—and produce an orange that I have readily sold three years in succession for twenty-two and one-half, twenty-two and twenty-one dollars per thousand, delivered at our depot (San Gabriel). I refer to this financial matter merely to prove one fact, viz.: that the oranges must have been superior to other oranges or I could not possibly have sold them at an advanced price. The soil here has given this superiority to the orange produced.

On the other great prevailing character of soil, the argillaceous, of moderate depth to the hard-pan, we have an orchard of six hundred trees of the same age as those of the one already described. Some of these trees are not so healthy, and do not produce a fruit to be compared in quality with that of the fruit grown on the other soil, although they have received more care and more thorough cultivation. On a gradually sloping hillside, where the naturally unfavorable conditions of this soil have been aggravated by the washing away of the top soil by irrigation, the trees are not half so large and are already showing unmistakable signs of decay; I am sure they will die in a few years. The highest price offered by the same merchant for the oranges produced by this orchard has never exceeded seventeen dollars and fifty cents per thousand.

We also have trees planted on the loamy soils that carry a large proportion of humus as well as clay. They are much younger trees, but they have now been bearing for two years;

the fruit is excellent and the trees are healthy. I also have an orchard on black soil, with the sub-soil near the surface. Though these trees are only ten years old, and seem to be as healthy as any others I have, they do not produce so good fruit as is desired, despite my every effort, by good and more thorough cultivation, to make them do so. Upon the same character of soil, on a *loose, gravelly sub-soil*, twenty acres of trees, now more than forty years old, are still in a healthy condition and produce most excellent fruit. These facts must lead to practical results and conclusions. They go to support my opinions, as already given, and are in accordance with well-known general laws.

All my experience has reference only to the mechanical conditions of soils on which the orange and lemon have been grown, and does not convey any idea as to the chemical elements of the soil, at least the quantitive elements.

It is an established fact that trees of the deciduous order require at least from six to ten times more alkalies in the soils on which they are grown than the evergreen varieties. It was proven by analysis that one thousand parts of the dry leaves of oaks yielded fifty-five parts of ashes, twenty-four parts of which consisted of alkalies soluble in water. The same quantity of pine leaves gave only twenty-nine parts of ashes, containing four and six-tenths parts of soluble salts.

# CHAPTER VI.

## Selection and Purchase of Trees.

The selection of trees for an orange orchard is a prime factor in the future success of the venture. The fully-established and generally well-known reputation of a nursery are landmarks in the journey for the selection of trees that cannot consistently be overlooked.

The healthy condition of the trees is the first item in which caution must be exercised. If the trees be healthy, they will be vigorous, and the foliage will be of a deep-green color. A tree suffering with disease or from bad treatment always declares the fact by its general appearance.

Trees for an orchard should have straight trunks and evenly balanced heads or tops, and be of a good strong growth. Trees from three to five years old from the seed are the best to set; not less than three nor more than five is a good rule to adopt. Old, dwarfed, scrubby, ill-shaped trees are dear at any price. Vigorous, symmetrical trees of suitable age should be selected, regardless of cost. Never look for low-priced trees, but rather those of fair price and good quality. Nurserymen who consider the wants of their customers cannot compete with careless, irresponsible imposters in the business. I quote from an editorial in the March number of the *Southern California Horticulturist* for 1878:

"The nurserymen of Los Angeles county have been stepping to the front during the past two or three years, and have raised large quantities of trees for shipment. The raising of orange trees at old-time prices was a very lucrative business, and nearly everybody had a seed-bed and a small nursery. The result was, the country became flooded with trees. Most of the small lots

of trees to be found scattered through the country were raised by men who knew nothing of the business, and who cared nothing about it beyond the planting of the seed and the selling of a few trees at from one to two dollars apiece. It is not at all to be wondered at that there are to-day thousands of worthless, scrubby, diseased trees, which have been thrown on to the market for just what they will bring, the owner considering whatever he receives for them is just so much found. Experts in the tree business cannot be deceived into buying this kind of stock; but, as a general thing, it is not this class of persons who buy trees. The average tree purchaser visits a nursery, gains all the information possible, finds out what he wants (from the nurseryman's standpoint), and then, if satisfied, leaves an order, with the injunction, 'Now, as I know but little about this tree business, I shall leave it entirely with you to give me good trees, and just such stock as you think I need;' and the man is fortunate if he is dealing with a nurseryman who will fill the bill conscientiously.

"The present low price of trees is driving all but legitimate nurserymen out of the business, and it will be a good thing for the country when this shall have been done. It is the poorest kind of economy for a man to pay ten cents for a scrubby tree when he can get a good healthy one for half a dollar."

# CHAPTER VII.

## Plan of an Orchard.

Our orange orchard is planted not only for ourselves but for our posterity for many generations; hence it behooves us to use judgment in planning and laying out so great and worthy an enterprise. He who successfully plants an orchard of citrus trees leaves a grand heritage to his heirs; he is a benefactor to his race. Then let us see that the work is properly done.

The distance apart to plant the trees is a question on which there is a multiplicity of opinions. It is a question of vital importance. If the trees be too close, the orchard will be dwarfed and almost ruined. Removing part of the trees will be an unsatisfactory remedy. Few will remove any ere it will be too late, for no one is anxious to destroy a bearing tree. After some of the trees shall have been removed the distance apart will generally be unsatisfactory, and, to a certain extent, irregular, breaking up the original regularity of the plan. If, on the other hand, the trees be planted too far apart, there will be an unnecessary waste of land and a needless expenditure of labor in cultivating—labor for which there will be no return. However, if err we must, it is better to plant the trees too far apart than too close. The extremes advocated are sixteen by sixteen feet and forty by forty. My experience prompts me to recommend planting budded or grafted orange trees twenty feet apart each way; lemons the same, whether buds, grafts or seedlings; standard seedling orange trees, twenty-four by twenty-four feet apart; limes, twenty by twenty. I consider these distances ample for the development of the trees.

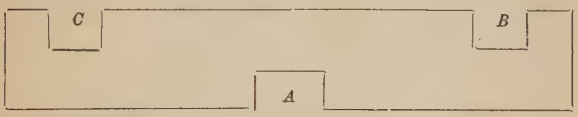
The best method of preparing a piece of land for planting: To illustrate, suppose the field to contain ten acres. Measure

off ten or twelve feet at each end of one side from the line of the fence or hedge that surrounds the orchard, or is to surround it. Measure off a corresponding line on the opposite side. Set pegs twenty or twenty-four feet apart on the lines already marked, and on the two sides of the field at right angles to them. If there be at one end a space less than the required distance, it can be regulated by setting the outside pegs nearer the fence or farther from it. It is better, however, to make the necessary mathematical calculations before setting any pegs. Ten acres in a square form equals forty rods square or six hundred and sixty feet. Deducting ten feet from each side leaves six hundred and forty feet square; six hundred and forty feet equals thirty-two spaces of twenty feet each. This gives thirty-three trees on a side, or ten hundred and eighty-nine trees on ten acres.

At twenty-four feet apart there would be twenty-seven spaces and six feet outside of the outside trees. To illustrate: six hundred and sixty divided by twenty-four equals twenty-seven, with a remainder of twelve; and the remainder must always be divided by two to make the allowance equal on each of the opposite sides. This would make twenty-eight trees on a side, or seven hundred and eighty-four on ten acres in a square. As six feet would be too near a line fence to set trees, eighteen feet would have to be allowed outside of the outside rows. This would leave twenty-six spaces, or seven hundred and twenty-nine trees on ten acres in a square.

Having set pegs on the outside lines, crosswise of the plat stretch a wire on which are tags at the required distance apart. Be careful to make the wire straight when stretching it. If the distance across the plat be considered too great for convenience, establish a line at a convenient distance from one of the base lines previously marked. A man will be required at each end of the wire to straighten it, and, if it be very long, one in the center. Set a peg at each tag on the wire, then remove the wire to the next row, and continue in this manner until the whole plat shall have been staked off. While staking, as already described, or afterward, complete the staking as follows: Take a piece of board about four feet long and four

inches wide, with a notch in the center of one edge of the board large enough to receive the tree; and near each end of the opposite edge of the board, and at equal distances from the notch in the center, a notch large enough to receive a peg, or bore a hole near each end. For the sake of convenience the notches ought to be cut as in this illustration:




Peg at A for the tree. Pegs at B and C. Place the board on the ground with the notch A at the peg where the tree is to stand, (this peg having been set when the wire was used as described above); then set pegs at B and C. Be careful to place the board on the same side of the pegs where the trees are to stand. For instance, if the board be placed on the west side of all the pegs marking the places where the trees are to stand, the board will be on the east side of the pegs at B and C, and no mistakes will occur in setting the trees. When the tree is to be set the board must be placed to the same side of the pegs at B and C as it was at the time of setting the pegs.

In digging the hole for the tree, the peg at A must be removed. The hole for the tree should be dug around the spot marked by this peg, and equidistant from it. Be careful not to disturb or cover the pegs at B and C. The pegs should be about a foot long and an inch square. They can be made very rapidly by sawing inch-boards into suitable lengths and splitting them into squares. The remaining part of the operation belongs properly to "Transplanting to Orchard," and will be found in the next chapter.

It pays well to take time to stake an orchard so the rows will be straight. If crooked or irregular, with here and there a tree out of line, it will be extremely disagreeable to the artistic eye, besides being more difficult to cultivate. When in straight rows, the plow or the cultivator can be run close to the trees, leaving little if anything to be done by hand.

By pursuing the foregoing plan the trees will be in rows in all directions; no squinting or sighting will be required when planting them. The work can be done systematically and expeditiously and at less cost than by many other more complicated methods.

# CHAPTER VIII.

## Transplanting to Orchard.

Transplanting to orchard is generally considered simple and easy, and, with few exceptions, it is done in too much of a hurry. The question is not, as it should be, how shall I proceed to plant my trees in the best manner to insure a quick and permanent growth? but, how can I plant my trees in the least possible time and with the least expense?

All possible dexterity consistent with the success of the venture is commendable and desirable; but when a proper degree of care is sacrificed to great haste and careless planting, in order to "finish the job," it is reprehensible in the extreme.

It is as important to know what month is best in which to transplant the trees as to know any other point in the business. There is some diversity of opinion on this point among experienced orchardists. I have planted many hundreds of thousands of orange trees, having planted in every month of the year. If extreme care and caution be used, even to the minutiæ, they can be transplanted at any time, and with some degree of success. I shall here remark that the orange tree is one of the hardiest trees known; they will survive very harsh and unhorticultural-like treatment; they will withstand drought and excess of water; they will live and make a stunted growth, with slovenly cultivation, when what are called our hardy trees would die. At the same time the whole order of the *genus citrus* responds most gratefully to proper treatment.

A glance at our own trees or those of our neighbors reveals their treatment at once, even to the near-sighted. If the reader doubt this statement, and he should ever visit the orange-grove settlements of California, notably Orange and Pasadena, in Los

Angeles county, and Riverside, in San Bernardino county, a look at the orchards will dispense with the necessity of an introduction to their owners to determine the status of their characters as horticulturists. Neighbors "Thrifty" and "Slack" will be known by the growth and the neat or slovenly appearance of their orange orchards.

I have found that May is the best month in which to transplant. There is then no danger of frost; the windy season is past; the ground is warm, and the weather is mild, being neither too hot nor too cold. There is usually more cloudy weather in this month in Southern California than in any other, not excepting even the rainy season. February is my next choice, but it has its drawbacks in the way of cold snaps, and sometimes windy weather in March, just at the critical time in the life of the newly-planted tree.

When trees are to be moved long distances, for instance, from the nurseries of Southern California to the northern counties of the State, I prefer the month of February, all things considered, in which to move them. Occasional hot spells occur in May in the northern counties, and for this reason, and this alone, February is preferable. June is better than March, and July is better than December or January. I have had less success in the fall than at any other time. I would rather plant in August than in October or November. But plant in May in the Southern part of the State, and in February in the Northern part, and you may reasonably hope to succeed. Even here, in Southern California, I prefer the month of February in which to transplant in some sheltered locations in the foot-hills.

The holes for the trees should be dug from two and a half to three feet in diameter, and the same in depth. If the soil be adobe, four feet in diameter and in depth will not be too much. Throw the surface soil to one side and the subsoil to the other, that the surface soil may be put in the bottom of the hole when the tree shall be planted and the subsoil above.

Two methods of digging the trees are generally practiced: First, to bag the roots; and, second, to puddle the roots, or cover with grout, after digging. The former method is the safer, but the latter, when well done, is the better. When the trees are to

be moved only a short distance, so it will not be necessary to keep them out of the ground more than forty-eight hours, I would puddle them. When this method is pursued all the fibrous roots can be saved and as much of the tap-root as the desire or caprice of the owner may wish. When dug in this manner, prepare for the roots an ample supply of grout, which should be as near the trees as circumstances will admit of. A large deep box, or a large barrel, or a hole dug in the ground, will answer as a receptacle for the grout. The grout should consist principally of sandy soil containing enough clay to make it adhesive; or, if it be too sandy, clay can be added; but it must be added cautiously, for too much clay is detrimental to the roots. Mix with water to a consistency that will admit of plunging the roots into it without breaking those that are small and tender. As fast as the trees are dug they must be coated with this garment of protection and packed away immediately in a shady place protected from winds, to remain till wanted for transportation. The roots must not, at any time from digging to planting, be allowed to get dry. The orange tree being an evergreen, the fibrous or feeding roots dry up surprisingly quick, and when once dry nothing can resuscitate them to their normal condition. The sun must not shine directly on the exposed roots.

Trees improperly handled while being dug and planted will not grow for a long time, if at all. If they grow, they will make a stunted, aggravating growth that will ever reproach those who are to blame for their crippled condition.

When packing them in the wagons of purchasers, or in boxes on railroad cars, a limited quantity of damp, partially rotted straw should be well packed around and among the roots. If it be necessary to water them, do it by sprinkling, and not by pouring water on them, as the latter will wash the grout from the roots. If a car-load of trees be shipped at one time, they may be packed in the car without boxes.

When they arrive at their destination be careful not to expose the roots unnecessarily to wind or sun. Remove from the distributing wagon no faster than wanted. Do not drop them ahead of the workmen, but hand them out only as fast as they are prepared to receive and plant them immediately.

I may be considered tedious in this matter, but experience has taught me that this is the critical juncture in the life and future usefulness of an orange tree.

Bagging trees consists in removing them with a ball of earth adhering to the roots. This ball of earth is covered with some kind of material tied snugly and closely to the ball with twine or bailing rope, to prevent the earth from cracking or from separating from the roots. The best material for bagging is burlaps, second-hand grain bags being generally used. The size of the ball of earth is governed by the size and age of the tree to be removed. The earth must be cut away near enough to the trunk of the tree to get the benefit of a mass of fibrous roots to be left with the ball. From eight to twelve inches in diameter, and from twelve to sixteen in depth, is generally as large as it is possible to leave the ball. If the ball be too large, its weight causes it to break away from the roots. Nothing but practical experience can enable one fully to determine the proper size of the ball of earth for the several sizes of trees. Those taken up in this manner do not require so careful supervision as those taken up by the former method. They must, however, be handled and lifted about carefully, and not be thrown or tumbled around in the manner most agreeable to the average freight-handling railroad employe.

If the earth be badly cracked, or broken away, then the object sought in bagging will be lost, and with it a large portion of the best roots of the tree.

When planting bagged trees do not remove the bagging, but plant it with the tree; it soon rots, and does the tree no harm. An attempt to remove the bagging may break the ball, or subsequent handling, while putting the tree in place, may destroy all the benefits sought to be derived from this method.

All trees should be pruned a week or two before being removed from the nursery, to enable them to recover from the shock always resulting from severe pruning. I recommend cutting the limbs back severely at this time—more than at any time before or after.

The condition of the soil at the time of removing the tree is very important. It should be in good order, thoroughly damp—

in a condition suited to the rapid growth of the tree. An orange tree seldom lives if removed from the nursery when the ground is very dry; if it does not die, it will be a long time after transplanting before it will show signs of life. Probably more trees are lost from this cause than from any other, though it may not be generally known. If the ground be dry when you are ready for the trees, let them alone till you have it in good order; it will pay to wait.

When planting the trees, use the notched board described in the preceding chapter. Three men, besides those required to haul and distribute the trees, can be used to advantage. One man places the tree in the hole, an inch or two deeper than it was in the nursery. First place the board with the notches at the ends snugly to the pegs on both sides of the hole, being careful to place the board on the same side of the pegs that it was when they were set. Set the trunk of the tree in the center notch and hold the tree perpendicularly. When properly placed, two men shovel in the earth, filling the hole evenly and uniformly from bottom to top; then tread the earth firmly around the tree, and the planting will be done. It will not be necessary to look back to sight, because the tree cannot be otherwise than in the right place, if the directions herein given be observed. It is not so important to have the proposed orchard, at the time of setting the trees, in so good a condition as the nursery at the time of their removal from it; yet it is desirable to have the soil in good working condition. The trees should be watered or irrigated as fast as planted. All leaning trees should be righted up on the following day, and, when necessary, the holes should be filled up again. All that will remain to do will be to cultivate as soon as the ground is in proper condition, then the orchard will be on the highway to success.

It may not be out of place to say a few words in reference to the tap-root. Some lay much stress on the advantage to be gained by removing the entire tap-root with the tree. It is my opinion that a tap-root cut from twelve to sixteen inches below the surface of the ground is as good as if cut at three feet or removed entire. I know that when the tap-root is cut at the former depth, from two to five tap-roots generally form, instead

of the one original root, and strike out at different angles, thereby acting as substantial braces to the tree, and penetrating the earth to a great depth. But save all the lateral and fibrous roots as nearly intact as possible, and the loss of most of the tap-root will do no material injury.

These remarks apply as well to other citrus trees as to the orange.

# CHAPTER IX.

## Cultivation.

If the cultivation of the orchard be but partially and imperfectly done, only a partial success will be possible. The soil must be kept mellow and clean at all times. The cultivation should be such as will leave the ground as nearly level as practicable, except in the fall just before the commencement of the rainy season. The ground should be plowed at this time with a turning plow, turning the soil to the trees; harrow down smooth; the trees will then be left standing on a slight elevation, and the winter rains will be drawn from them to the dead furrow in the center of the spaces between the rows, thereby preventing an excess of moisture at the roots. The ground is cold in winter, and it is detrimental to the health and growth of the tree to allow water to stand near the trees to injure the roots. An orange tree will not flourish in this climate when the roots stand in soil filled with water.

Land that is liable to be washed by heavy rains should be plowed crosswise just before the commencement of the rainy season, and left rough, to prevent washing.

The best implement for general cultivation is a horse-hoe, an Acme cultivator, clod crusher and leveler, or a spring-toothed or chisel-toothed cultivator, or some other implement that will thoroughly pulverize the soil and destroy the weeds. Care must be used to cultivate the ground close to and around the trunks of the trees as well as between the rows. This can be easily done with the implements referred to in the hands of a skillful operator, and no other kind of a workman should be allowed to work in an orchard. An inexperienced or careless hand will generally do more damage to the trees in one day's

work than a skilled workman would do in a whole year. Do not, under any circumstances, postpone from week to week the cultivation of your orchard. Commence early in the spring, running the cultivator almost continuously till late in the fall; then finish, as already stated, with a turning plow.

After the rains are over, in the spring, use a turning plow again, turning the soil from the trees, leaving the ground level.

There is not a unanimity of opinion among horticulturists as to the depth to which an orange orchard should be plowed. Some favor shallow plowing; some, deep plowing. I approve of and advise plowing not to exceed two or three inches in depth adjoining the trunk of the tree, and within a radius of four feet from it, increasing the depth gradually from this point to the center of the spaces, the greatest depth not to exceed six inches Two annual plowings are ample—one in the fall, as herein stated, finishing in December, and commencing again in February or March. Thereafter during the year a cultivation not exceeding three or four inches in depth will be all that will be required.

# CHAPTER X.

## Irrigation.

I am one of those who cannot persuade themselves to believe that complete success in orange growing can be attained without irrigation. By thorough cultivation, as recommended in the preceding chapter, an orchard on some exceptional soils may be successfully grown during the period of the early growth of the trees, or until the time of fruiting, without artificial irrigation. If non-irrigation be persisted in after fruiting shall have commenced, the fruit will be dwarfed and unsavory. Time alone can determine whether or not I mistake on this subject. One thing is true, however; an ample store of water for use in emergencies is a safe and wise provision. Though I believe irrigation absolutely necessary, I know it is a curse of great magnitude to many orchards in this country. This point will be more fully explained in the chapter on "Diseases of Orange Trees."

Various methods of irrigation have been practiced, some of them for an indefinite length of time, while some are comparatively new. Latterly, underground irrigation is the great innovation on all preceding methods. The philosophy of irrigation, in connection with a common-sense view of the latter method, recommends this method to all thinking, practical minds. The cost of manufacturing and laying the necessary piping has hitherto practically placed an embargo on this system of irrigation, preventing its general use. I understand, however, that the cost has been reduced to a comparatively low figure, and it is to be hoped, and it is reasonable to presume, that time, experience and improvements on the methods now in use may so simplify the manufacturing process, and so reduce the cost,

that underground irrigation will become universal in the near future, over all this State. It is certainly the most natural method now known of applying water for the purposes of irrigation. In this utilitarian age in which we live, cheapness, economy and simplicity go hand in hand with the introduction of all useful and labor-saving appliances, in all departments of life.

The following editorial on the subject of underground irrigation is from the *Southern California Horticulturist:*

"The system of underground irrigation, by which the water is supplied by means of pipes laid eighteen inches below the surface, though used in older countries when irrigation is necessary, has but recently been introduced into Southern California, and it is yet an experiment here.*

"We lately visited the place of E. M. Hamilton, of East Los Angeles, to examine the system now being introduced by him. We found a two-acre orchard, the trees of which were set in the spring of 1877. A well, a windmill and a reservoir holding some 40,000 gallons were at the upper corner of the orchard. His well is sixty feet deep, and a twelve-foot windmill lifts about 5,000 gallons per day.

"A system of asbestine stone pipe is laid throughout the orchard, with a system of valves and hydrants so arranged that the entire orchard can be irrigated at once, and the water can run as long as desirable, without putting a single drop on the surface of the soil. A pipe is run from the main, down along each row of trees. Plastered into the upper side of the pipe, opposite to each tree, is a manufactured stone plug through which there is a quarter-inch hole. This hole is loosely plugged, so as to allow a seepage when the water is turned on. A piece of pipe is stood on end over this plug, to keep the soil from coming in contact with the hydrant. This piece of pipe comes a few inches above the surface of the ground. The operator can visit each hydrant as the irrigation is going on, aud see just how much water is escaping; if too much or not enough, the flow can be easily regulated.

* Since the above was written the matter of experiment has developed to a practical certainty, that sub-irrigation is the system that will soon be universally used. November, 1881.

"The objections to some systems of sub-irrigation have been that the fibrous roots of weeds and plants would work into the pipe through the openings for the escape of water, and thus choke up the pipe; also, that as the water was running out of the pipe, at the lower end of the tract, after the water from the supply pipe had been shut off, the pipe would suck mud from the openings at the upper end, thus filling up the pipe. Both of these objections have been overcome by the system adopted by Mr. Hamilton, as neither roots nor mud come in contact with the openings in the pipe.

"The advantages of sub-irrigation are many. In the first place, but a very small proportion of the water used by the flooding system is needed by using this system of pipes; hence, a given water supply will extend over a much greater surface. This is a great saving, as water is worth more than land. When the system of pipes is once established, the work required per acre is much less than when the surface is being continually flooded. Again, the work of irrigating an acre of orchard by this system is nothing as compared with the necessary work of making the ditches and basins every month, before the irrigation, and plowing and cultivating them up again, as is now practiced.

"The ground cannot bake when sub-irrigation is used. A man can irrigate when he pleases, and cultivate when he gets ready, and no harm is done. The moisture will extend from twelve to sixteen feet each way from the irrigating pipe, in a sandy or loamy soil, so that when a system of pipes is laid through an orchard, with a pipe along each row of trees, the entire area of the orchard is kept moist and in condition to produce crops.

"Some five years ago we had a long conversation with I. N. Hoag, who was then Secretary of the State Agricultural Society. He had seen a system of underground irrigation tried in Sacramento. He gave the theory a hearty indorsement, but the system referred to by him is liable to the criticism above mentioned—the pipe would fill up with roots and suck mud.

"Can the system be cheapened any?

"We do not wish to be understood as advising the system of

sub-irrigation as practiced by Mr. Hamilton; we desire to awaken discussion and experiment. If there are other objections to the system we should know what they are.

"Mr. Hamilton's trees made a very vigorous growth last season, and at the end of the season the soil was in a very good condition."

The following is from the report of the investigating committee appointed by the Southern California Horticultural Society:

"The systems of irrigation in use throughout the district are varied. Many use the old system of flooding the entire ground every three or four weeks, using water to the exclusion of cultivation. Others irrigate less and cultivate more. We find, in fact, all phases of irrigation and cultivation, from all water and no work to all work and no water. Neither extreme is profitable, but a golden mean of two or three thorough irrigations, with thorough cultivation, your committee believe the orchardist will find the most successful. On heavy soils the water should not touch the tree, and great care should be exercised after each irrigation that the ground may not bake."

The following discussions and papers read on the subject of irrigation, before the Horticultural Society at its September session, 1877, are appended almost entire. It will be found that the whole ground has been ably discussed, and much that is useful and beneficial can be gleaned from the discussion. The essays are all from practical men of great experience, and reflect substantially and concisely the knowledge gained by years of close application. Portions of some of the papers deal almost exclusively with questions of law and equity, and will interest the student in this branch of the subject. In using, in this connection, the discussions and essays, and in making quotations for other portions of this work, I give them substantially as the Society received them, leaving the readers to judge for themselves the matter they contain.

Practical Irrigation, by Robert Lyon, of San Buenaventura:

"To the Southern California Horticultural Society: Gentlemen—The subject selected for discussion at your present meeting is of great personal interest to me. All of my land is subject to irrigation. I have experimented for the last sixteen years in

the various modes of putting water on land. I have found the following rules applicable under all circumstances :

"First—Irrigate before the growth of trees or plants is checked for want of sufficient moisture to sustain a healthy, vigorous life. If the land be permitted to become so dry that the leaves of orchard trees wither or curl up, then the small surface roots will be already dried out, and cannot be resuscitated. Water will prevent such trees from dying, but their growth will be materially retarded. If a bearing tree be permitted to become very dry, it will shed its fruit after an application of water.

"Second—Wet the land thoroughly, down to moist earth, but do not drown it with water for two or three days. Surface irrigation (I mean passing the water rapidly over the land) has a tendency to attract the roots to the surface for moisture, instead of causing them to seek it deep down in the earth, as they will when land is evenly wet all the way down. The roots will follow the moisture down as the land dries out from the surface. We often see a man irrigate his land for the first time ten weeks after the last rain in the spring, and perhaps his land will not even then be too dry. He will irrigate every ten days thereafter during the summer, and his land will be very dry every time. Reason why: The land was thoroughly wet in the spring, since which time only the surface has been irrigated.

"Third—Work the land thoroughly from two to five days after irrigation, or when it is sufficiently dry to crumble and is not sticky. If the soil be well pulverized from four to six inches in depth, with plow, spade or cultivator, and the surface be then smoothed down with a rubber, it will retain moisture twice as long as if irrigated and left without working. I believe this rule will apply to every variety of soil, and that land that will retain moisture four weeks when not worked after irrigating, will retain sufficient moisture ten weeks if the soil be properly cultivated.

"Fourth—It is injurious to run water immediately over the roots and around the trunk of the tree when there is not sufficient water to flood the entire surface. I plow a furrow about three feet from the trees, on each side of the row, and let the water run in these furrows from twelve to twenty-four hours.

When the land is sufficiently dried out, I take one horse and a plow, fill in the water furrows, and plow all the land that has been wet. I then smooth down with a leveler, or rubber, and the land will remain in good order for a long time. I do not know that this mode of irrigation is better than any other; but after many experiments in the different modes of irrigating an orchard, I prefer it to any other I have yet tried."

The author's remarks: "The subject under discussion is of more than ordinary importance. The area of arable land in this district is almost unlimited, amounting to millions of acres of first-class agricultural and orchard lands.

"The question of water for irrigation is the only one to be solved in order to settle and plant these lands. Some may claim that orchards can be successfully grown without irrigation, but I am decidedly of the opinion that he who undertakes to plant and raise an orchard without water on our dry and best fruit lands will ultimately fail. Thorough and systematic pulverizing of the soil will, of course, assist to retain moisture, and it will lessen the amount of irrigation to a considerable degree.

"I take the position that when a practical and economical system of irrigation shall have been adopted, and the water now developed, and what can be developed, shall be put into practical use, we shall have an ample supply to enable us to cultivate orchards on all the arable lands of the district. It is apparent, then, that the question of an ample supply of water, distributed by an intelligent system of irrigation, lies at the very foundation of our prosperity as an agricultural and horticultural community. It is self-evident that the very best plant will grow and be developed and matured out of the united experience of the practical application of the water at our command. Theoretical plans amount to very little on this subject, as they do on most other practical subjects, as compared with the stern facts arrived at by a practical application of the principles involved.

"We find a number of different plans of distribution. The old and primitive general custom of this country, a custom pursued by the Spanish residents, was to check off the land to be irrigated into sections or squares, the size of the sections being

governed by the grade or slope of the land. When this plan is used, the land is irrigated by filling these sections and then allowing the water gradually to penetrate the ground.

"For the irrigation of crops at the present time, our farmers usually conduct the water by or along each row of the crop, in a furrow made with a plow. The ground is stirred immediately after each irrigation. I believe this plan is generally considered the best for the cultivation of ordinary crops.

"For orchard purposes some planters still pursue about the same plan as the above for crops. While the trees are small, for instance, a furrow is turned from the trees, on each side of the row, with a one-horse plow. The soil is turned back and thoroughly cultivated, after irrigating, leaving the surface level.

"After an orchard is fully established, say five or six years after planting, it is found best to use a two-horse plow, turning a furrow away from the trees, and on both sides of the row, at least four feet from the trunk. This leaves a strip eight feet wide between the furrows. The water is turned into these spaces and spread evenly over the ground, flooding this strip thoroughly. Then, when the soil is in proper condition, this space is cultivated thoroughly and leveled with a horse-hoe, cultivator or other implement. The length of time that should elapse after irrigating and before cultivating, depends mainly on the nature of the soil. I have found this to be an excellent plan where water is plenty; but where it cannot be had in sufficient quantities, other and more economical methods must be resorted to.

"The orchards at San Gabriel Mission and in some other localities are irrigated by making basins around the trunk of the tree. The basins are made by scooping the earth from the tree, and forming around the tree a circular bank or ridge, of sufficient capacity and strength to contain water enough to penetrate the ground thoroughly. These basins should be made with a diameter to correspond with the diameter of the tops of the trees. I am of the opinion that this plan of irrigation, all things considered, is the best now in use. It enables us to use a running stream of large or small capacity, to use a hose from hydrants, to water from portable tanks on wagons or carts, to

fill these basins as often as required to carry an orchard through our dry seasons. By mulching these basins from four to six inches in depth, with half-rotted straw, a very small amount of water and labor will suffice to keep the trees in a continuous growing and healthy condition. When the rains begin in the fall, this mulch is plowed into the soil, making an excellent fertilizer. The ground is leveled and kept so during the rainy season. The basins require constructing but once a year. It is really a pleasure to cultivate an orchard managed in this way. There are now in this county experimental orchards of five or ten acres or more, cultivated successfully and cheaply on this plan, where running water is not obtainable, the water being drawn into tanks from wells by wind, horse or steam power, and distributed as desired from portable tanks. I am fully convinced that by adopting this system of irrigation, orchards can be successfully and cheaply raised on our dry mesa lands, where water is not more than seventy feet from the surface."

P. M. Green's remarks: "The practical use of water in irrigation, as a factor in the production of crops, the time and manner of using the same challenge our most careful consideration. It is a question of much more importance than that of budded or seedling fruits, and transcends even the question of markets and of supply and demand. I believe it is now universally conceded that irrigation is a necessity in fruit-growing in this country, and especially to the production of citrus fruits. It is true that the prosperity of Southern California is not wholly dependent on irrigation, for abundant crops of many kinds are annually produced without it. It is equally true that those productions which must ever remain its chief boast and the source of its greatest profit, are in a great measure, if not wholly, dependent on irrigation. He who would at this day attempt the growing of an orange orchard without an abundance of the life-giving element, water, with which to carry his trees through the dry season, would be deemed a fit subject for a commission to determine his lunacy. The running streams, springs and artesian water supply constitute, in fact, the bed-rock of our prosperity as a fruit-growing country; without them our occupation, as fruit-growers, would be 'gone' indeed. While nearly all are

agreed as to the necessity of irrigation in the production of citrus fruits, with scarcely enough exceptions to mark the general rule; while nearly all agree theoretically on the subject, it has been found that when we come to the actual use of water in irrigation, a great variety of opinion is evolved as to the time, frequency and amount of irrigation necessary to the most nearly perfect tree growth and fruit production. So great is the diversity of opinion on this subject, as well as on many others connected with fruit-growing, that it is the subject of remarks by strangers making inquiries into the business, and many claim they can obtain no reliable and uncontradicted information on the subject. Many a beginner in the business, anxiously seeking facts by which he may be guided, finds himself in a maze of conflicting advice. It is probable that, in a very great measure, this contrariety of opinion grows out of the great variety of soils in this part of the State, some requiring much heavier and more frequent irrigation than others, thereby rendering impossible the laying down of any general rule applicable alike to all.

"The purpose of irrigation being to supply the want of natural moisture in the soil in dry seasons like the present, or during the dry months of any year, so as to obtain the best tree growth, and the production of the best and largest crops of fruit, the question arises, how may these be obtained? The free and unrestricted use of the waters of our streams and springs for winter irrigation, is, in my opinion, the remedy to be applied to guard against the effects of a dry season like the present, when there has been a deficiency in the usual rainfall, and the ground has not received the thorough saturation to which it is accustomed. Our water sources are ample for this purpose, supplied as they doubtless are from the snow and ice of the lofty Sierras, and stored away by the hand of Him who 'holds the winds in His fist.' They require a succession of hot, dry seasons, like the present, to unlock their aqueous treasures fully, and send them trickling down the rugged mountain sides and on through their subterranean outlets to this sunny plain of ours.

'If we but consider what a small fraction of the water for a year is actually used on our lands, that our water supply is

abundant for effectually flooding all our irrigable lands during the non-irrigating months, does not admit a doubt. It is probable that the ground itself is the very best reservoir for the storage of water for summer use. Certainly this is measurably true. If we thoroughly saturate the soil by winter irrigation, do we not wholly obviate the effects of a dry season? Do we not make the season a wet one for grounds thus treated, and, for all practical purposes, render ourselves in a measure at least independent of Jupiter Pluvius? The winter months are particularly adapted to this work; the water supply is then not only more abundant, but the short days, long nights, and more or less cloudy weather and consequent impeded evaporation, prevent the too rapid drying of the surface soil, and favor that thorough stirring and pulverizing of the ground which should always follow irrigation. This subject of fortifying by winter irrigation against the effects of dry seasons, and diminishing the amount of summer irrigation that would otherwise be required, is one demanding our careful consideration as orchardists. There need be no fear of putting too much water on our lands, or that the winter waters are too cold, for they are not ordinarily colder than the winter rains.

"The month of June is early enough to begin the work of summer irrigation, in seasons of ordinary rainfall, or on lands that have received the proper winter irrigation, especially if the soils are in any way retentive of moisture. If the trees are growing rapidly, or producing full crops of fruit, they will need irrigation by this time, to replace the draft made by them on the moisture in the soil. Let me refer, in this connection, to a simple but often overlooked fact. Trees that are fruiting or making a rapid growth are great consumers of the moisture in the soil, while those that are not fruiting or not growing rapidly consume comparatively little moisture. In the first case, abundant and frequent irrigation is necessary to supply their demand, while in the latter instance little irrigation, if any, is needed.

"Much difference of opinion prevails as to the quantity of water that should be applied at a single irrigation. On compact soils with close and retentive subsoils, light and frequent

irrigations are probably best, while on soils with good natural under-drainage, or disposed to be 'leachy,' irrigation may, and probably should be, heavy—heavy in contradistinction to an irrigation which simply wets the surface of the soil a few inches in depth. Water should, in all cases, be applied in sufficient quantity so that the moisture therefrom will fully meet the moisture from below, otherwise the effect will be to produce an undue amount of surface roots—a thing to be carefully avoided.

"As to the frequency with which orchards should be irrigated, much depends, as referred to above, on the thrift of the trees, whether they be fruiting or not, and perhaps still more on the character of the soil for retaining moisture. The practice of some, of allowing their trees to show signs of distress before irrigating them, is a vicious one. As well may a man fast until emaciation before eating, without injury to himself, as that trees be allowed to show signs of withering before supplying them with their needed moisture. Perhaps perfection in irrigation would be to keep the soil at all times, to the very farthest point to which the roots extend, in a state of what may be called 'growing moisture.' There need be no fears, as are entertained by some, that by so doing trees will be unduly stimulated and induced to make an unnatural and unhealthy growth. They are governed by fixed laws in their growth, and under no circumstances will they take up more food from the soil than they can assimilate and appropriate to their legitimate use.

"The practice of mulching the ground around the trees merits a passing notice in this connection. The advantages of this are obvious in the case of small trees or those newly planted. A mulching of rotted straw or coarse manure retains the moisture, by preventing rapid evaporation, and in our cool nights retains the warmth generated in the soil by day, thus equalizing its temperature and thereby favoring growth, and by shading the ground from the direct rays of the sun, enhances its fertility in addition to that derived from the decay of the mulch.

"The necessity of thorough cultivation, stirring and pulverizing the soil after each irrigation, would seem so self-evident as to require no mention here were it not so often neglected. This negligent habit of leaving the ground undisturbed after

irrigation, a habit conceived in culpable ignorance and brought forth in inexcusable indolence, *is* one of the most pernicious in tree culture.

"It is a fact that nothing else so compacts and solidifies the soil as does water; and this is particularly the case when water is poured into basins around the trees and allowed to soak away into the ground. When after-cultivation is not practiced, the soil—no matter what its character, no matter how soft and friable—soon becomes close and compact, hard and unyielding, and in many cases, under the sun's influence, great fissures are formed to a depth sufficient to damage the young rootlets. Few soils, if any, will long bear the neglect of after-cultivation, and all are benefited by it. The claim sometimes set up, that the fertility of the soil is continually renewed by irrigation, is not justified by experience. It is doubtless true that in the regions of the Nile, that are subject to an annual overflow from floods in the region of its sources, by which large vegetable and sedimentary deposits are carried down and spread over the land, this annual deposit perpetually keeps up the fertility of the soil; but the waters of our springs and rivers, flowing in no instance more than a few miles, and fed as they doubtless are by the meltings of the driven snow, or their waters distilled by God's own hand amid the inaccessible peaks of our loftiest mountains, pure, bright and sparkling as the dew-drop that glistens in the morning sunlight—waters pure as these contain no sediment rich enough to supply the drafts on the soil's fertility.

"To those of other sections of our country, where rains are so abundant and frequent as to render irrigation unnecessary and who are therefore disposed to commiserate our condition on account of the extra labor imposed on us by our climatic conditions and the necessity of irrigation in our choicest productions, let us, in acknowledgment of their well-meant but mistaken sympathy, point them to some of the practical results of irrigation, as mirrored in the world's history. Let us point them to that most ancient of all empires, Egypt, pre-historic in its beginning, the cradle of the arts and sciences, the feeder of God's people in famine-stricken Canaan, and of whose magnificence and grandeur we obtain but faint glimpses in the remains

of its monuments and temples, that have withstood the ravages of forty centuries. Let us point them to the orange groves that fringe the Mediterranean, and whose green and gold are reflected by every wave that washes the shores of that inland sea—to those of Palestine, Spain, Italy and the adjacent isles, which for generations have been the source of the world's supply of the golden fruit, all of which is produced by irrigation. The superiority of this fruit, grown in a dry climate like ours, in its solidity and keeping qualities, and our ability to transport our fruit around the world, if necessary, without material loss, more than compensate for the extra labor in its production. If ours is a more laborious lot than that of others, let us be thankful that a healthful and invigorating climate vouchsafes unto us the physical ability for the task we have voluntarily taken upon ourselves—that of establishing and building up the choicest fruit-producing region in the world."

Mr. Holt gave his experience in irrigating at Pomona. He had charge of the Pomona Orchard Company's orchard. He had planted nearly 16,000 trees since May, 1876, most of which are orange, lemon and lime. The orange orchard covers two hundred acres. It is located on a sandy, loamy soil. About 6,000 trees were put out last season. He gave the entire tract a thorough irrigation last winter, by running water for twenty-four hours down each row of trees and each place in which a row of trees was to be planted this season. He estimated that the quantity of water thus run upon the tract, during the winter season, would cover the entire tract to a depth of fifteen inches. He had found irrigation necessary this season, but he was not prepared to say that with good winter rains it would be impossible to raise an orchard successfully without any irrigation. He rather inclined to the opinion that it could be done. A portion of the trees put out by him last season and thus treated to winter irrigation received no additional water until the middle of August, and about fifteen hundred of them would probably need no more irrigation this season; yet they are in a very thrifty growing condition at this time. He did not quite agree with Mr. Green, that rapid-growing trees require more irrigation than those that grow more slowly. It is true that the more

rapid the growth, the more moisture is required; but his experience showed that the thrifty trees had sent their roots deeper into the earth, and had gathered an abundance of moisture, while the less thrifty trees, having more circumscribed roots, feel more quickly the lack of moisture. He had had no experience in mulching, but believed it would pay to cultivate thoroughly and enrich the soil, as less irrigation would be needed under such treatment, and a much more rapid growth would be secured.

Mr. Carter, of San Gabriel, believed it to be injurious to trees to put water next to their trunks. He irrigated some trees, and killed part of them, by running the water too long around the trees.

Mr. Thomas had been examining orange groves extensively during the past ten days. Pasadena had the best system of irrigation in the county. The trees in that settlement were making the best growth, considering the quantity of water used, of any he had ever seen. If all the water could be used as economically and effectually as the stream is used that supplies Pasadena, there would be enough to irrigate every acre of land in the county. Less irrigation would be necessary if people would cultivate more. He believed in winter irrigation, and that ground should be thoroughly soaked at a time of the year when water is most abundant.

Remarks by J. W. North: "The application of water to the earth's surface, in the mode and time and in quantity to produce the best result in this State, may very properly be termed the grand art of husbandry and horticulture. The study of this art is especially called for in our portion of the State, and here are its greatest achievements; yet we are only in the infancy of knowledge on this subject. The adequacy of our water supply is little known. The arts by which it can be raised from great depths, in quantities for irrigation, are but imperfectly understood, yet they are being constantly improved upon and are already much advanced. The application and control of running streams, and the art of making them the most useful, are yet, to those best informed, in the experimental stage; but they are being studied with increasing care and assiduity. Upon

this branch of the subject the best efforts of political economy and legislative wisdom are especially called for.

"To protect alike the interests of capital and labor, to hold the balance of justice even between the rich and the poor, between the large proprietor and the man who has only his garden to cultivate; between powerful corporations and citizens of limited means that depend upon large irrigating canals for their water supply—should be the special care of the law-makers of the State. The wealthy and influential classes find little difficulty in having their interests protected by legal enactments; but this is no reflection upon our wealthy classes or upon the law-makers. Those who have the sagacity to obtain wealth have also the sagacity to obtain for it all necessary legal protection. They have the means, the time, and the ability to apply to the legislature and to obtain the needed legislation. This is as it should be. A government that fails to protect its enterprising citizens in their rights and property, is undeserving of the support of a free people. But the highest glory of a State is, that it protects the humblest citizen as completely as it does the most exalted, and holds the rights of the man of limited means as sacred as those of the millionaire. Both classes have a good degree of protection in our State; yet the experience of each succeeding year teaches that legislation for the protection of the masses in their rights is still incomplete.

"A single individual who has the means may appropriate water sufficient to supply a thousand or ten thousand people. A corporation may do the same thing, and the law protects the rights of the corporation or the individual, as it should do.

"The appropriation and diversion of water is often attended with large expenditure, that none but individuals or corporations of ample means can afford. When such appropriations are devoted to furnishing towns and settlements with their needed supply of water, the appropriator becomes a public benefactor. If the water appropriated is used properly, the people have no reason to complain of a monopoly; but, on the other hand, they have reason to be thankful that the water they had not the means to appropriate is brought within their reach. Here the law has sought to guard the rights of the people, by

providing that while the right to water may be obtained by appropriation, the appropriation must be for a useful or beneficial purpose, and that when the appropriator ceases to use it for such useful or beneficial purpose, the right ceases. The limitation of the ownership of water to its beneficial use is all in the interest of the people, and if observed in good faith, it is a most salutary protection. But the appropriator has so wide a range of beneficial uses that, without further safeguards, the people would still be left very much at his mercy. The rights of the appropriator are quite fully guarded, but his duties are not so clearly defined. Considering the crude notions of vested rights that have heretofore prevailed, it is perhaps not to be wondered at that so many corporations have adopted the idea that they have many rights, but no duties, while the people dependent on them have many duties, but no rights. As this seems to have been the popular view in the past, and to have wrought many hardships on confiding people, let us consider, on this occasion, the duties of water companies, and the rights of people depending on them.

"Settlement by colonies is becoming the favorite method of peopling the unoccupied portions of our State. Some of these are composed almost entirely of Eastern people. A few persons organize themselves into a company or corporation, obtain a considerable tract of land, appropriate a considerable supply of water, and then advertise for settlers. A large number come from the Atlantic States, bringing their all, and investing it in these colonies. Confiding in the good faith of these companies, they buy lands, build dwellings, and plant orchards, vineyards, and orange groves. These colonies expand until the water supply is not sufficient for the land sold or occupied. Then the confiding settler begins to inquire about his claim on the company for his water supply. And what if the company coolly inform him that they intended to treat him well, but that he has no legal claim for water from their ditches on any terms? If it suit their convenience, they will sell him water; but they say it is entirely optional with themselves. The settler then wakes up to the fact that he has placed himself entirely at the mercy of others; that is, he is at their mercy if the law is what

they claim it to be. He has fine lands and a beautiful home. He has fruit trees and vineyards sufficient, when in full bearing, to afford him a fine income. But it is all entirely worthless without water; and this is all he has for himself, his wife, and his children. If the company withhold water from him, he is ruined. If they continue to furnish him as they have been doing, and he understands that they are under no legal obligations to do it, he feels that he is living only on sufferance; that he is entirely dependent on the good will of the present officers, and that though he may be secure in the favor of these, he knows not how soon a new set may ruin him.

"Another has brought from the East fine stock—the best breeds of cattle and hogs—and, allured by the advertisements of large water supply, he buys land, builds a house, sows alfalfa, and is just beginning to develop his useful industry, when he learns that the company do not recognize any legal claim on them for a future supply of water; and, rather than place himself permanently at the mercy of a corporation, he sells his fine stock at a sacrifice, and finds himself nearly destitute, and living where he may be utterly ruined, whenever the company shall so please to do.

"When hundreds of families with valuable homes and orchards, vineyards, and orange groves are depending on the water supply in which they have rejoiced for a few years, what is to hinder the ditch owners from buying other lands below, and taking a half or the whole of the water supply from the first settlers to supply the new purchasers?

"If the settlers undertake to protect themselves by buying water stock, is there any limit to the number of shares the company may issue, if they are unscrupulous enough to organize for a large issue?

"If the company have twice the quantity of land that their irrigating ditches can supply, what assurance has the first purchaser that the last purchaser will not deprive him of half his water just at the time when his orange grove shall have come into bearing? Or what assurance, other than verbal promises, has the last purchaser that he will get any water at all, if the first purchasers should be regarded as prior appropriators?

"What legal limitation is there to the representations of speculators? What law is there to restrain them from promising water to a thousand purchasers, when they have only sufficient for a hundred? If the settler wish to appeal to the sense of justice and the human impulses of the company, he often finds that the real company is at San Francisco, hundreds of miles away, and that the men he has been dealing with are but figure-heads and agents of the real power. He is situated, in fact, like the Irish peasantry who occupy the estates of absentee landlords residing in England. The peasants may suffer, and starve, and die, but the absentee does not hear their cries or behold their wretchedness.

"Water companies should be required to have their chief office and their board meetings where the people live who depend upon them for water.

"I have thus far spoken of the condition of the settler, and the claims of the water company; but I would not for a moment admit that the settler is destitute of legal protection, as the law now stands. He is not so dependent as they would have him believe. He has rights, clear and substantial, and such as can be enforced. Great principles of law may be obscured, overlooked and forgotten for a time, but when their need is felt they stand forth in vindication of the right.

"When Lord Mansfield judicially announced that 'slaves could not be held on English soil,' he awakened, of the English Constitution, a principle that had slept for centuries. When the founders of our Government sought for its corner-stone, they found it under the rubbish of ages. The principle of 'human equality' is a very old one — as old as humanity itself; but, like a choice gem, it needed a new setting, which they gave it.

"The growth of wealth, of corporations, and of new combinations of capital for great enterprises, attracted the attention of law-makers for a time, as was very natural, to the partial neglect of the individual and the masses; and, as was natural, powerful corporations magnified their prerogatives, and often assumed powers the law never gave them, but which poor men found it difficult to resist. But poor men have learned that 'in

union there is strength,' and that by organization they can protect their rights even against monopolies. The battle fought by the Grangers with railroads, speculators and middle-men, is a conspicuous illustration of this fact. The recent decision of the Supreme Court of the United States, in the Grange cases, is richly worth all it cost. By this decision the duties of corporations and the rights of citizens are made plain. The decision itself bears directly upon the right of State Legislatures to control corporations, and all that invest money in a business in which the public are interested. It enunciates principles which bear upon water companies as well as upon railroads. The leading idea is this: That corporations have duties as well as rights, and that all that engage in a business on which others depend, shall discharge the duties incident to that business faithfully, impartially and at reasonable rates. Nor is this any new doctrine. The Chief Justice, in rendering the almost unanimous decision of the Court, quotes freely from English authorities two hundred years old, and enunciates principles as old as civilized government—principles reiterated, it is true, in the Magna Charta and in our own Constitution, but existing for centuries before either of them. These principles require each citizen so to conduct himself and use his own property as not to injure another unnecessarily. They regulate the conduct of citizens towards one another, and the manner in which each shall use his own property, when such regulation becomes necessary for the public good.

"On this principle the Chief Justice says: 'It has been customary in England from time immemorial, and in this country from its colonization, to regulate ferries, hackmen, bakers, millers, wharfingers, inn-keepers,' etc.

"He further says: 'Looking to the common law, from whence came the rights which the Constitution protects, we find that when private property is affected by a public interest, it ceases to be *juris privite* only. This was said by Lord Chief Justice Hale, more than two hundred years ago, in his treatise 'De Partibus Moris,' and it has ever since been accepted without objection as an essential element of the law of property. When, therefore, one devotes his property to a use in which the public

has an interest, he grants to the public, in effect, an interest in that use, and he must submit to be controlled by the public for the common good, to the extent of the interest he has created.'

"And again: 'If they will take the benefit of that monopoly, they must, as an equivalent, perform the duty attached to it, on reasonable terms.'

"Again, he speaks of the common carrier, the miller, the ferryman, the inn-keeper, the wharfinger, the baker, the cartman and the hackney-coachman, as pursuing a public employment, and exercising a kind of public office.

"As these all have special privileges and protection, they also have special duties required of them by law, as have railroad and water companies. The duty expected and required of each is to do well and in good faith just what he proposes to do, and what he invites the public to expect of him. The common carrier must serve all impartially and at reasonable prices. The hotel-keeper must serve all that come, to the extent of his ability, with impartiality. The ferryman cannot discriminate or drive a hard bargain with one who wishes to cross his ferry; he must serve the public faithfully and impartially. So with the railroad company; it can refuse no one who wishes to travel or send freight. So, according to our statute, with a water company that supplies a city or town; it must serve all at reasonable rates, and without distinction of persons. So, when a company commences to furnish water for irrigation, it must continue to do so, and the use of the water is declared a perpetual easement to the land.

"The law, so far as it goes, is in the right direction. There would seem to be no need of new principles, or of new modes of their application. What seem to be needed are, greater facility and completeness in their application.

"First—Individuals and corporations that invite settlers to depend on them for water, should be required by statute to carry out, in good faith, what they propose in their charters and in their circulars and advertisements.

"Second—When persons have settled and made homes at their invitation, and, as they knew, depending on them for water, they should not be allowed to oppress such persons by

new terms and hard bargains, or to take from them their water supply.

"Third—If such settlers have come in good faith, and made homes, and have obtained ten, twenty or eighty acres of land, and have not yet commenced to cultivate it, the water company should be bound by statute to furnish a supply as fast as needed, if it can, until all his land shall be under improvement, and then continuously in exact compliance with its articles of corporation and its advertisements. They should be required by the statute to carry out, in good faith, their professed purposes, promises and implied promises.

"Fourth—Water companies should be prohibited from extending their operations beyond their water supply. If a company has sufficient water for only one hundred families, it should be made a penal offense, as well as a case for damages, to deceive twice that number, and induce them to purchase and settle, relying on false promises. Such a mode of obtaining money under false pretenses is no better than the worst form known to the law. The ordinary confidence-man takes but a small portion of his victim's money, but water sharps sometimes aim at all he has. If they are successful, the man is left destitute of even a home for his family.

"Fifth—In cases in which the water supply is limited, the first settlers should have the preference. Having invested their all in improvements, relying on the water, which was then abundant, they should not be deprived, by any subsequent settlement, of a complete supply for their lands.

"Sixth—When settlement has been made at the invitation and by the encouragement of companies proposing to supply water, and said companies afterward neglect or refuse to supply the settlers with water, as they had been encouraged to expect, there should be a mode of relief more speedy and less expensive than an action at law. There should be an officer empowered to afford relief at once, so that no trees or vines would suffer before relief could be obtained from the courts. A water police may become a very useful branch of local government. If a man on the street be assailed and robbery be attempted, a public officer will protect him at the public expense. If the

same man be assailed at home by a ten-fold greater danger, and his water supply be threatened—a supply on which depends the value of his property and the life of his family—he will be left to grapple alone with a gigantic monopoly, and sometimes with a corporation that boasts of its wealth and the protracted litigation it will inflict on the poor settler unless he do its bidding.

"The disadvantage under which citizens labor in contending with water companies are of the same nature as those formerly experienced by the individual farmer in contending with railroad companies.

"The Grange taught the farmers how to unite and extort justice from the most gigantic corporations. It was a hard struggle, and one that required long years of patient toil, but victory came at last. The recent decisions of the Supreme Court of the United States, in the Grange cases, places the humblest farmer and the wealthiest corporation on terms of entire equality before the law.

"Scotland's great bard has said:

> 'Freedom's battle once begun,
> Bequeathed from bleeding sire to son,
> Though baffled oft is always won.'

"The struggle of the farmers was at first a formidable one. Wealth, influence and organization were all against them. The ablest lawyers in the land gave learned opinions sustaining the power of the corporations. Even the writers of law books were borne along by the popular current, and gave no hope to the farmer. But persistent effort for the right never goes unrewarded. Though the Granges of the United States never achieve another victory, they will be entitled to the lasting gratitude of mankind for what they have already done. But the victories they have achieved are going to make it easy to win other victories for the right. The doctrine laid down by the Chief Justice, in his late opinion, does much to simplify the water question. If our law-makers will study it, and let their legislation be guided by it, little more will be needed.

"The protection of the rights of the humblest citizen, the protection of the labor, the property and the homes of the

producing classes, are among the first and highest duties of government.

"The aristocracy of a nation are relatively of little account; they could be spared without any great shock to the public interest; but when the laboring classes are oppressed, crippled, wronged or paralyzed, the nation suffers. The best interests of monopolies themselves are best promoted, though they may not know it, by a scrupulous regard for the rights of the producer. We look in vain for general prosperity in any nation in which labor is degraded. No State needs to heed these plinciples more than California, whose prosperity depends so much on immigration from the East, and nothing else has retarded the prosperity of California so much as the insecurity of land and water titles. If we would bring wealth and good citizens to our coast, we must see to it that those who come will be fully protected in their homes and industry.

"The rights of individual claimants and first appropriators on running streams, and the rights of riparian proprietors, and of subsequent appropriators, are, as regulated at present, sources of perpetual conflict, irritation and obstruction to industry. There is great need of thorough and wise legislation that will deal with the whole subject, and so regulate it as to afford water to the greatest number, and that, too, without injury to any. Whether or not this end can be achieved without the State's asserting entire ownership of the water, is a question. If any better mode can be devised, it should be brought forward without delay. I am free to say, for myself, I can think of no other plan so likely to secure the rights of all, as for the State to assume entire control of the water. All vested rights must, of course, be respected; but there is a direct and easy way in which private property may be taken for public use, namely: by paying its appraised value. When 'civil service reform' shall have secured to us honest men in all public offices, it will then be safe to trust the State, and then will come the 'Golden Age' of peaceful industry, when water suits will be unknown, and when the interests of each individual will harmonize with the best interests of all. May our law-makers possess the virtue and wisdom to hasten a consummation so devoutly to be desired."

Remarks of J. De Barth Shorb: "Irrigation is of so complex a character, viewed in whatever light you may choose, that the more one reads and studies the recognized authorities upon the laws and customs of the different countries in which irrigation is practiced, the greater seems the difficulty in wisely generalizing, or coming to any definite or fixed conclusion as to what system of laws is best for us to adopt to meet our requirements more fully.

"It must be remembered that in Italy, Spain and India there have been concentrated on this subject some of the best engineering brains in Europe, financiers of experience and high standing, and statesmen of the first ability; of the latter, Count Cavour, of Italy, stands prominent.

"Now, when the difficulties they met proved too great, in many instances, for them to overcome, we must not expect to find it a work of easy accomplishment, or that our efforts will not be attended with many mistakes.

"I confess extreme reluctance to write on a subject, knowing so well my inability to do even partial justice to it or myself.

"Man's wants are so different under the various conditions of his social life; so much affected by the form of government under which he lives; and he is to so great an extent the creature of circumstances—of climate, soil, temperature, prejudices, customs, etc., surrounding him—that, while a code of laws might be admirable in the application to one country, they would utterly fail if used for the government of others. It has been suggested, however, by one of our esteemed associates, that by bringing together the practical ideas and opinions of the many, and duly comparing their merits or defects, a better understanding of this subject may be arrived at, and some practical suggestions given to our legislators that may enable them more fully to understand the necessities of the case, and thereby assist them in their efforts to pass such general laws governing and directing the disposition of the waters of the State, or those under its control, which the emergency of the case seems imperatively to demand.

"Irrigation in some form or other has been practiced far back into the remote ages, and, perhaps, to the time of pre-historic

man. Long before the commencement of Solomon's Temple there were irrigating works and reservoirs of enormous dimensions, the remains of which are still in existence. The Pharaohs of Egypt had their irrigating canals, and divided their time and resources in supplying with grain what was then a contracted world, and in supplying themselves with monuments to last through all time. These monuments remain to-day, serving only to satisfy the idle curiosity of the tourist, or cause discussions among archæologists—certainly of no practical value to man. But irrigation, which they did much to develop and foster, has come down to us through all these ages, and is to-day the same grand, wealth-producing agent as when man first inhabited the East, and recognized, in his developing engines, the necessity for a surer and more ample supply of food than that which sprung spontaneously from the soil.

"Spain, under the Moors, may possibly supply us with more valuable information, lessons and suggestions than any other country we may choose to study.

"The Moors have shown wonderful skill and intelligence in the construction of their irrigating works, and in the institution of their executive, legislative and judicial systems, regulating the equitable distribution of the waters—possibly more than any other people. In many provinces of Spain their works, laws and customs remain unchanged.

"Such being the case, does not the conclusion naturally suggest itself, that if such customs and regulations, bequeathed by the hated and despised Moors to their conquerors, have stood the test of practical experience for centuries, without essential change, despite the efforts of the government to obliterate every trace of Moorish rule and occupation, they must of necessity be wise and good? May we not derive from them many valuable lessons for our guidance here?

"It may be a matter of interest to refer generally and as briefly as possible to the franchise laws of Italy and Spain, laws under which companies have incorporated to construct irrigating canals and works in those countries, the general features of limitation of their powers, and of the customs, laws and regulations controlling the disposition and distribution of the water.

"Recognizing the necessity of irrigation, and fully appreciating the enormous increase of taxable values in real estate, and the absolute annual increase to the nation, in the production of wealth resulting therefrom, the Governments of Italy and Spain have been most liberal in their encouragement to irrigation enterprises. Italy pursued a course very much like that of our own Government in assisting the railroad companies, but with this marked difference: while the interest on the bonds issued by the company was guaranteed by Italy, she did not give away her land. She remitted all taxes for a certain term of years, and guaranteed the companies against loss by confiscation in time of war, etc. Although these canals and works are the private properties of the companies, they are always held subject to the jealous control of the Government first, and are rendered more or less subject to the rules and regulations of irrigating associations through whose lands the canals are constructed. These associations are composed entirely of the actual irrigators and workers of the soil. Their representatives or officers enter into contracts with the canal companies, from time to time, for a definite number of cubic feet of water per second during the irrigating season, for a certain fixed sum. These contracts are generally made by individual members of these associations, who in turn farm out the water to others. The companies themselves do not assume the distribution of the water after it leaves their canals, nor are they held responsible for it. In Italy the water districts are divided by canals, as in Spain. Each district elects members to a water legislature that meets twice a year, to elect their own executive and judicial officers, to hear complaints and grievances, to settle disputes, assess taxes, etc.

"In Spain, the Moorish system still being adhered to, each canal forms an independent district of its own. The irrigators of these districts meet only once in every two years, to elect their permanent administrative committee, to assess the taxes for repairs and current expenses, and to appoint their officers for the ensuing two years. The presiding officer of the district is called the Syndic, which would correspond in position to a general superintendent with us. In qualification he must not

only be a proprietor of the soil, but one who actually holds the plow, and whose character is beyond reproach. This officer has absolutely the entire control of the distribution of the water in times of scarcity and drouth, and, making himself acquainted with the conditions and needs of the growing crops in his district, he decides who and what crops are most in need of water, and to that crop and owner the water is given, without fear or favor. These first officers, or Syndics of the different districts, form a tribunal of justice, that meets once a week in front of the Cathedral of Valencia, to summon offenders, hear complaints and decide as to the rights of contestants. This tribunal hires no clerk, keeps no record, and defers no judgment until some future time; but after hearing all the evidence, at once decides, from the judgment seat, all questions. The jurisdiction of this court is absolute in matters of fact—that of police over those who appear before it.

"It may well be supposed that this court of peasant judges has often been assailed. The Government has more than once attempted to make changes more in harmony with the usual course of procedure; but the steadfast attachment of the people interested in the tribunal has sufficed to maintain it substantially as it descended from the Moors.

"It is a noticeable fact, and one to which I desire especially to call your attention, that among all these rules and regulations, qualifications for membership, etc., the legal fraternity is scrupulously excluded from all participation in the conduct of cases; and whenever they come before these august tribunals, they, like other men, are made to stand off at a respectable distance, hat in hand, head uncovered.

"Would that America were permitted to establish such tribunals with equal jurisdiction over special cases—tribunals that might decide in conflicting claims, without the intervention of lawyer or jury. We could then have in this land more peace, more law, more justice, more love among neighbors; and the occupation of many legal gentlemen having been taken from them, we would have more actual producers, more irrigators and cultivators of the soil. I would now suggest to our legislators that if they desire to enlighten themselves, they earnestly

study this subject, read the recognized authorities, find out what other nations have done, what laws they have passed, then listen to the suggestions of practical irrigators, and know what they are about, and not jump at conclusions by hap-hazard and pass laws that will benefit no one but the lawyers. In making this article one of suggestions to our law-makers, I cannot improve upon the conclusion arrived at by the very able Board of Government Commissioners on the irrigation of the San Joaquin, Tulare and Sacramento Valleys—composed of General Alexander, Colonel Nundelle, of the Engineering Corps, U. S. A., and Professor Davidson, of the Coast Survey.

"I have taken much from their report; I have read and studied closely many of the authorities they quote; I have weighed well all they have written, and I unqualifiedly indorse their conclusions and their suggestions as to the proper legislative action of both Government and State, that they may control and direct irrigation in our own country.

"I quote at length some of their conclusions: 'As a matter of public policy it is desirable that the land and water be so joined, never to be cut asunder, that the farmers would enjoy in perpetuity the use of the water necessary for the irrigation of their respective lands; that when the land is sold, the right to water shall also be sold with it, and that neither shall be sold separately; that the parties chiefly benefited by irrigation are farmers or land-owners; that there is every reason to believe that the value of land in the driest districts will be appreciated many fold; that it results from this that lands should, as far as possible, pay for the construction of the necessary irrigating ditches; that the State and counties will be directly benefited by the appreciation of lands, and by the increase of wealth, in their revenues from taxation; that, consequently, it may be good policy for them to aid such enterprises; that whatever aid is given by the State or county should be extended in a continuous way; that in many parts of the country where irrigation will ultimately best repay expenditures, there are now no people; that the population must be imported; the houses, barns and equipments of the farms must be created before returns can follow the investment; that for these reasons we must look for

a comparatively slow development of the country. That while we believe, as we have already stated, that the best policy is for the farmers to build and own the canals, we also believe that when the farmers are unable to build, and when the State is unable or unwilling to build, it may be, and probably will be, the best policy to invite the aid of private enterprise. We refer, in support of our opinion, to numerous instances in Spain and Italy in which this system is now in successful operation.

"'That private companies undertaking such enterprises should be subjected to certain conditions, some of which are as follows: That after a stated period the franchise shall pass in favor of the State, or of the irrigators, or that after a certain period the State shall have the right to purchase on certain previously defined conditions.

"'That the prices of water shall be fixed by agreement, each party in interest being represented by arbiters.

"'That the State shall have the right to charter an association of irrigators to administer the works, the company merely selling the water, but having nothing to do with it after it leaves their channels, the association making all arrangements for its distribution and for the collection of the water rates. The latter provision has several advantages. It relieves the company from the odious duty of discriminating in times of scarcity, and from the endless disputes that attend the distribution of water, and puts the responsibility on the irrigators, where it belongs. It favors each irrigator, for he becomes a member of a company strong enough to stand up for its rights in any contest with the capitalists. For a successful system of this kind, we refer to the 'Association for Irrigation in the Vercelles, in Italy,' given elsewhere in this report. That we see no reason why the rights of farmers and the rights of capitalists may not be adjusted by some such plan, on the basis of justice and mutual interest. We observe that the conditions just referred to place a company of capitalists in the light of temporary owners, and that they contemplate a period when the works shall be owned by the State, or by the farmers. That when any of the canals are built, the State should establish a system of inspection by which a proper construction shall be secured; that the quantity of water to be

taken from a river at its mean stage, for the irrigation of a definite quantity of land, should be fixed by a reasonable rule, so that those who come late shall not find all the water taken up, and so that proper drainage shall be secured.

"'That such supervisor will probably be distasteful to parties consuming; that nevertheless we believe it is essential to future prosperity, and that its neglect now will bring a fruitful crop of contention in the future, will delay the development of the country, and, by irrigation unhealthful, it may make it odious.'

"With some modifications, the general laws of Spain and Italy might be made applicable to the management of the waters of our rivers or other natural supplies of mountain streams.

"Each district might elect its own board of commissioners, that would appoint its own general officers and superintendents; and the county to elect an officer at large, whose duty would be the supervision of the entire irrigating works of the county. It is a difficult matter, if not an impossible one, to pass any general State law that could in justice and fairness be made to govern all the districts. A general law would, in its provisions, be so conflicting with pre-existing rights that I am clearly of the opinion it would not answer. The law should allow each district to manage its own water matters, under proper restrictions, as the mining class have always done in their local affairs, and which management the courts have always stood ready to sanction and confirm.

"As the climatic conditions in our own State, small rainfall and so high temperature in all our interior valleys, make the necessity of irrigation more apparent than in either Italy or Spain, and as the results are of so great importance to the country at large, I believe all proper irrigating enterprises should receive the aid of the Government, State, counties and districts in which they may be undertaken. They should receive from the Government the carefully-given aid, where the Government still has lands unoccupied and unproductive; from the State, when the magnitude of the work to be undertaken, and the consequent greater increase of values to the State, would justify; from the counties, when several districts would

be interested; and, finally, from the districts themselves, when the benefits would be more or less localized.

"Surely, if the Government, States, counties and cities were at all justified in subsidizing and giving the aid to build our railroads from ocean to ocean, or to those that traverse our country north and south, and placing the companies now operating them in such a position as almost to defy the Government and State authorities, in carrying out their own selfish policies to the detriment of the counties and their own interest as well, they have more reason to give assistance to companies that may hereafter be formed to carry into successful operation irrigating enterprises, which are of far more benefit to the country. A mile of railroad, as a realty, can be assessed at only a small part of its real value, and it never becomes more valuable; but a mile of ditch, carrying a generous supply of water, may in time give values reaching millions of dollars. I think, therefore, all proper aid should be given to any company that, in embarking their capital in irrigating enterprises, would bring into usefulness thousands of rich acres which must ever remain unoccupied and worthless until the great vitalizing agent, water, shall be supplied to them. The increase of taxable valuations would more than repay a thousand fold all that the Government, State or district might in reason give canal companies for irrigating purposes. We should always bear in mind and continue to consider the fact, as an incentive to do our duty, that in every part of the world where irrigation has been generally practiced there have been the happiest and wealthiest people of the world.

"Owing to the extravagant management of the present Khedive of Egypt, that country has accumulated an enormous debt, and during the last fiscal year was considered hopelessly insolvent; but under the careful and better management of the English Board of Finance, which is now a part of the Egyptian administration, she has paid the July coupons of her bonded debt, besides carrying a handsome surplus, and is declared to be in a fair way to work herself out of debt in a comparatively short time.

"Egypt has been found so much richer in her resources of

wealth, mainly owing to the construction and care of irrigating canals on the part of the Khedive, that English bondholders are so happy and contented over the discovery that they are going to get back their money loaned to Egypt, they wish to demonstrate, in true English spirit, their condition of mind and heart by taking possession of the country and annexing it to the British crown.

"In conclusion I will state as my opinion, founded on actual experience in the management and distribution of water, that we have enough water in our rivers and natural springs, if properly reserved and distributed, to irrigate all the valley lands and upper mesas of this county.

"With proper laws and fair encouragement on the part of our State, county and district authorities, as well as land-owners, this will be a question of only a few years for its accomplishment. Then we shall have no more of drouth or bad years, and we shall become the richest people of the world, agriculturally and horticulturally, and, as a natural consequence, the happiest."

# CHAPTER XI.

## Crops Admissible in a Young Orchard.

How am I to live and support my family while my orange orchard is coming into bearing, is the question arising in the mind of the average grower of limited means. It is a question of much importance, as the universality of orange-growing depends upon its favorable solution.

The general advice, which admits of no argument, would be, plant your orchard and cultivate the ground solely for the orchard; plant nothing thereon but trees, and make a living independent of the ground planted to trees. All that have followed this plan are unanimous in their verdict that this will undoubtedly insure success. But hundreds who have a few acres of land adapted to orange culture would enter the business, if an annual subsistence could be procured on the same land, but who could not otherwise be induced to venture. I think some comparatively harmless crops may be recommended for this class. Of the cereals, corn only is admissible, always leaving a strip not less than eight feet wide—four feet each side of the row—for the use of the row of trees. Corn does not sap the ground and apparently poison it for orange trees, as many other crops are sure to do. Corn being a staple, it can be planted quite generally to advantage. Pumpkins, squashes and melons are harmless crops. If the culture of the sugar-beet, which is now attracting attention, be made successful and remunerative here, and I see no good reason why it cannot, it will, in my opinion, prove to be a sovereign boon to the poor orange-grower till his orchards commence fruiting. I think they can be planted with impunity between the rows of orange trees; and at the generous prices usually paid for them in the

vicinity of sugaries for the manufacture of beet sugar, they would produce a yearly income sufficient to solve the query at the commencement of this chapter. Orange culture and sugar-beet culture have no war at issue.

It is as important to know what *not* to plant in a young orange orchard as to know what is admissible. Never sow any kind of grain, or anything that will not admit of cultivation. Never plant potatoes. Small grains sap all the ground, and potatoes are a hot-bed for gophers. Beans, though apparently harmless, are great absorbers of moisture, and will leave the ground dry as an ash-heap.

I know of no admissible crops other than those enumerated. The safest plan is to plant only half of the contemplated orchard and raise crops on the other half.

# CHAPTER XII.

## Fertilizing.

The arable land of California is generally exceedingly rich and fertile. Fields have been cultivated to ordinary annual crops, in various localities, for generations, without receiving any kind of fertilization, except what has been received from the water in irrigation; and they yet produce crops equal to those of former years. Two crops are taken off annually, in many instances, and with no apparent diminution in yield. Thousands of acres have been cultivated to the cereals for a consecutive period of twenty-five years, or longer, in large portions of our State, producing abundant crops annually when the rainfall was ample. Perhaps no country responds more promptly and faithfully to the demands of the husbandman, without fertilizing remuneration, than the arable lands of California. Large orchards are producing abundantly without having received any artificial fertilizers. This has led many to think fertilizing a useless expenditure. It is thought, however, by many progressive horticulturists that our orchards will grow more thriftily, produce more abundantly and a finer quality of fruit, with an ample supply of manure. I doubt not that this is true in principle, and that a judicious supply of manure applied annually to our orange orchards will certainly stimulate the tree to a vigorous and healthy growth, and produce an increase in size and productiveness and a better quality of fruit.

All manures should be thoroughly composted before being spread in the orchard. Partially rotted manures do more harm than good, in my opinion, except, perhaps, when well incorporated with adobe soils, which may thereby be made more friable. On the ordinary and best soils for orange culture only

well-rotted manures should be used. It should never be mixed with the soil when filling up the excavation at the time of setting the trees. I have tried this method to my regret. It increases the heat to an unnatural degree, which requires an unusual quantity of water to modify, and damages the trees very much. Spreading the manure evenly on the surface of the ground around the tree, to a distance equal to the diameter of the top, is the proper method of applying it. It is as well to put none nearer than a foot or so from the trunk of the tree. It is a good plan to cultivate well soon after manuring, to mix the manure thoroughly with the soil.

The best time at which to apply the manure is in the fall, just before the commencement of the rainy season; then subsequent irrigation and the rains carry the liquid manure down to and among the roots of the trees, where it is appropriated for the growth of the trees.

Good judgment and common sense are as necessary for the proper application of manures as in all the other divisions of the subject under consideration.

# CHAPTER XIII.

## Pruning an Orange Orchard.

Some horticulturists consider pruning a necessary evil. It would be a superfluous operation, if the tree would grow symmetrically without it and in the best form to produce the best crops of fruit. There is much diversity of opinion on this important branch of the science of horticulture. Various methods are pursued, from that of allowing the trees to branch at the ground, to that of commencing to form the top at an unreasonable and undesirable hight; from that of severely letting them alone, allowing nature full and unrestrained sway, to that of a continuous cutting and hacking. Perhaps so wide a difference of opinion and practice does not exist among our fruit-growers on any other branch of fruit culture.

November, December or January is the proper season for general pruning. The trees grow less during these months than at any other time. January is immediately prior to the season of blooming. The annual pruning should be done before the fruit forms. At all seasons of the year, however, all superfluous sprouts on the trunk, and all stray branches that threaten to throw the tree out of balance, should be removed without delay. Pruning should be done with a sharp implement, to make a smooth cut that will heal and be covered with bark in a short time. A rough, haggled cut does not heal readily, and in some instances it never heals. It has doubtless a tendency to injure the tree constitutionally, from which injury it never fully recovers. All cuts made with a saw should be pared down smooth with a sharp knife. When large limbs are removed, and it is sometimes necessary to remove them, the cut portion ought to be painted with shellac in proper solution to spread easily.

There are involved in pruning several principles, among which are the following:

First—The removal of the branches from the trunk of the tree, to admit of cultivation close to the tree with a horse and cultivator.

Second—The removal of part or all of the limbs that cross or rub one another, or that grow too close together, diverging from one point.

Third—Thinning out the center of the top of the tree, cutting out all non-producing branches, to admit an ample supply of air and light.

A wide diversity of opinion exists on the first proposition. There are strenuous and enthusiastic advocates of low pruning, allowing the branches to grow within two or three feet of the ground. The usual arguments in favor of this method are, that it shades the trunk of the tree from the direct rays of the sun, and that it also shades the ground, thereby preventing evaporation, as it is claimed, to a great degree; hence, a moist condition of the soil.

The advocates of what is termed "high pruning" are no less enthusiastic in defense of their theory. They argue that it admits of better and more thorough cultivation, even close to the tree, and at less expense than if the top be allowed to form near the ground. They say the entire surface of the ground, and especially the soil near the trunk of the tree, should be well cultivated, not only for the purpose of destroying the weeds, but to pulverize the soil for the retention of moisture; and that the direct rays of the sun should, as far as possible, fall upon the whole area of ground in the orchard. Our most experienced orange-growers think the soil needs the warmth of the sun, as well as cultivation, that the trees may receive the full benefit of the moisture in the ground, and that the fruit may be fully developed.

In low pruning, as the trees increase in age, the area densely covered with shade by the limbs and leaves increases till eventually only a small part of the soil receives the benefit of the sun's rays. The soil must consequently be comparatively cold continually, and not so conducive to the health and growth of

the tree. Nearly all kinds of plants, deprived of the unobscured light of the sun, make a pale, sickly and unnatural growth. Plenty of sunshine (the more the better), with an ample supply of moisture and thorough cultivation, are the prime requisites to promote a quick, healthy and vigorous growth, and to cause us to realize the full fruition of our hopes in the size, quality and general excellence of the product. I believe in high pruning and recommend it. The trees should at the same time be trained to grow stocky, with a strong, healthy trunk, which it will be difficult to attain by constant and persistent pruning. I think the plan of depriving an orange tree, four, five or six feet high, of all its limbs, except a little tuft at the top, necessitating the use of a stake to support it—a method practiced by some orchardists—is the most pernicious of all. This makes a vice out of the virtue of high pruning. Before young trees are transplanted to the orchard they should be allowed plenty of limbs, which make them develop a stocky trunk and a large quantity of roots. When about to be planted in an orchard, they may be deprived of a portion of their lower limbs, and then be pruned up gradually till a horse or mule can pass readily under the branches. This is about the best rule to guide the orange-grower. When, after years of growth, or from heavy bearing, branches become too low, the ends can be trimmed from underneath till the orchard will present a regular and uniform appearance. Properly trained orange trees do not need stakes to support them; they will support themselves, and with a little assistance they will grow symmetrically and well proportioned.

The center of the top of an orange tree, more particularly of one that is fruiting, should receive an annual pruning of the superfluous inner branches, and such a cutting out of the inside limbs as will leave the inside of the top open and clean, and admit air and sunlight throughout the interior of the tree. All branches inclined to grow out so as to present an unsightly appearance must be cut back.

If the foregoing rules be observed, the orchard will always be in order to receive visitors, and will present to tourists examining our country an appearance that will cause the owner to feel proud of his arboreal possessions, and, what is of still more

importance to him, it will insure him a full crop of well-formed fruit that will be luscious and marketable, especially if raised in a suitable locality.

I do not presume to dictate as to the best of the different methods of pruning, but simply give my preferences and their advantages as I see them, leaving the intelligent pomologist to decide for himself.

# CHAPTER XIV.

## Diseases of Orange Trees.

Orange trees in California enjoy an enviable reputation for healthfulness. Perhaps in no other part of the world does the citrus family enjoy immunity from disease to such an extent as in our own beloved and golden country. The orange groves of many portions of the world have suffered from what is known as "die back," the new growth of the season dying back to the old wood. It is thought that this disease is occasioned by the roots coming in contact with the hard-pan, which they cannot penetrate. We have had nothing of the kind in this country up to the present time. The only disease for which we have reason to seek a remedy is what is known as the "gum disease." Trees affected with this disease are known at a glance by a general sickly appearance; the leaves grow yellow gradually. The leaves drop off in the extreme stage of the disease, leaving on the leafless tree the fruit, which never attains perfection. The trees die and dry up soon after the leaves fall. The disease commences at the surface of the ground; the bark rots away, and from the affected parts the sap exudes in the form of a gum. This disease extends until it encircles the entire trunk, usually extending from two to six inches up the trunk, and downwards to the roots and along them, oftentimes to their extremities, rotting the bark on them, thus cutting off all connection between the soil and the tree.

Excessive irrigation and poor or slovenly cultivation are admitted by all to be the cause of this dreaded disease. A committee appointed by the Southern California Horticultural Society was instructed to visit the orange groves of Southern California, one of their objects being to ascertain the cause of this gum disease and the remedy for it. This committee visited all the principal

orchards in Los Angeles and San Bernardino counties, and became convinced that the reason given above is true. They made their report to the Society on this basis. The report was unanimously adopted, after due consideration. The disease is most prevalent where excessive irrigation is practiced; trees in depressions in which the water stands in pools after irrigation are most affected, and sometimes they are the only affected trees in the orchard. The disease is also more destructive in orchards in which the water is allowed, while irrigating, to come in direct contact with the trunk of the tree. Orchards on high, well-underdrained land, that receive irrigation only when absolutely necessary, and that are carefully cultivated after irigation and before the ground shall have had time to bake and crack, are always found free from this disease. The term "gum disease" is, I suppose, a misnomer. Strictly speaking, it is not a disease; it is simply the result of improper treatment of the trees.

The prevention of this so-called disease consists of putting into practice the ideas advanced above relative to irrigation and cultivation. To prevent the contact of the water with the bark of the trunk of the tree, there should be turned towards the trees, before irrigating, a ridge consisting of two furrows made with a turning plow on each side of the row. It is not necessary to run the plow deep. The space between the rows should be cultivated in such a manner as to leave the trees on the highest ground, with drainage toward the center of the space.

There is really no cure for trees affected with gum disease, unless it be in its early stages. The best and only effective plan is to scrape off from the roots and the trunk of the tree, with a sharp knife, all the decayed bark, being careful to scrape the wood clean, that no diseased portion may be left, and then return the soil to the roots and trunk. It may be well to apply a coat of gum shellac to the parts cleaned, to prevent the moisture of the soil for a while from penetrating the exposed wood. If the tree be not too badly affected, new bark will soon cover the affected part, and the tree will be saved. But when the bark is rotten entirely around the trunk, and the disease extends to the roots, it seldom pays to attempt a cure. To remove the tree and plant another in its place is the most profitable plan to pursue.

# CHAPTER XV.

## Destructive Insects and Remedies.

The orange groves of California have been troubled many years with what is known as *black scalebug*. This insect or parasite attacks the limbs and twigs of the trees, and, in extreme cases, the trunk and the limbs; but I believe it is never found on the leaves or the fruit. I have observed this pest for many years, and have found it most abundant on starved, stunted, ill-cared-for trees, and in nurseries in which the trees were so crowded as to suffer for want of room, and, consequently, for want of sunshine. It is also more prevalent on low lands, or lands not fully adapted to the development of the tree. In many instances trees that were literally covered with this insect at the time of their removal from the nursery, have become clean and bright in a short time after having been planted on high, warm land; the parasite soon disappears. It is conceded that in many instances in which it abounds in orchards, such orchards have an unenviable reputation for bad treatment, and that proper treatment often causes the bug to disappear. We find, indeed, that proper and thorough cultivation is the true prevention of this pest and the remedy for it.

A variety of scalebug that is new to us has made its appearance within a few years past in some of our orchards. It is known as the *red scalebug*. It is much smaller than the black, and is of a yellowish brown or iron-rust color. The appearance of this insect is the advent of a real enemy to successful orange culture. It covers not only the trunk, the branches and the under side of the leaves, but also the fruit, in its season, giving it a mottled, spotted and scarred appearance, thus rendering it comparatively unfit for market. As soon as it is known that it

has obtained a foothold in an orchard, no time should be lost in destroying it thoroughly and effectively, for it spreads with wonderful rapidity. No half-way measures will do; heroic and untiring energy must be used to destroy it and prevent its spreading over your own and adjacent orchards. It is generally believed that this dreaded scourge was introduced into this country on trees imported from Australia. The dorthena or white scale, a formidable enemy to the orange tree, is somewhat prevalent at present. This, also, was undoubtedly imported from Australia. The remedies suggested in this chapter for the red scale are also applicable to the white scale. That this is true of the red scale, the fact that it was unknown here before we imported trees from that country, may be adduced as evidence.

It appears already to have made considerable progress in our country. A year or two ago it was known only in two or three orchards in one locality, but it is now found in several places miles apart. Colonies and neighborhoods cannot be too cautious in using every possible means to prevent its introduction.

I do not consider its presence fatal to the business; it does not kill the trees, so far as I know, but it is an expensive and damaging evil that must be eradicated from our country.

I may here remark that it is said by those who have been dealing in Mediterranean oranges, the red scale was on the fruit in the New York markets more than thirty years ago; that recently the fruit has been so thickly covered with this parasite as seriously to interfere with its sale.

The following is from a letter to the New York *Sun:*

BURLING SLIP, NEW YORK, March 29, 1879.

"To the Editor of the *Sun*—SIR: My attention has recently been called to an article published in the *Journal of Commerce* of the 18th instant, on the subject of parasites on Mediterranean fruits—lemons and oranges. The inference to be drawn from the article is, that the origin or appearance of the parasite on Mediterranean fruit is of recent date. This, however, is not the fact.

"The existence of this dreaded pest was known to fruit-dealers

in this city more than thirty years ago. The varieties of lemons and oranges most affected by the parasite were imported then, as now, from Naples, Palermo and Sicily. But never before has the fruit from those places been so thickly covered with parasites as during last year and this—so much so as seriously to affect the price of lemons and oranges imported from those places. The only variety of West India oranges affected (slightly) by the parasite is imported from Kingston, Jamaica. Its existence there is comparatively of recent date. To illustrate the disastrous effects of parasites, not only on oranges, but also on orange trees, I would state that previous to the year 1849 the oranges imported from Matanzas, on the decks of sugar vessels, were of superior size and quality and commanded a fair price. A few years later the orange trees and fruit, especially in the suburbs of Matanzas, became thickly covered with these insects, in consequence of which the fruit was greatly diminished in size and comparatively of low value, so that the importation of Matanzas oranges gradually decreased in number, and about eight or ten years ago ceased entirely. Not a few orange trees in and around Matanzas were entirely destroyed by parasites.

"The injury inflicted, and likely to be inflicted, on Mediterranean lemons and oranges by these destructive insects is a serious matter for contemplation, and unless some effective plan can be devised to check the growing evil, much loss will ultimately be sustained by the growers. The value of lemons and oranges annually imported into New York exceeds $2,000,000.

"The writer has had many years of experience in the cultivation and treatment of numerous varieties of fruit trees, and the only remedy known to him that will eradicate and effectually destroy the parasite is to thoroughly scour the bodies and larger limbs of the affected trees with sand and common soap, repeating the operation once a year, or until the insect shall have entirely disappeared. The effect on the trees of the alkali applied as above stated is truly wonderful in accelerating their growth and productiveness. J. H. BOSTWIC."

Fertilizing and good cultivation will not rid the trees of the

red scale, as they will the black. As a remedy, some growers cut away the entire top of the tree, down to the large limbs, and remove all branches and thorns, to admit the free use of remedies applied by washing by hand, and rubbing and scrubbing the entire remaining portion of the tree with some insect-destroying compound. Others have adopted the plan of forcing a spray of parasite-destroying liquid throughout the whole tree with a force-pump to which is attached a hose with a finely perforated sprinkler. The liquid may be carried to the trees on a tank on a wagon. When this is properly done it reaches every part of the tree. It is claimed to be the best method of applying remedies for the destruction of these parasites.

It is my opinion that this insect—the red scale—will be entirely eradicated from our country within a few years.

I have sometimes thought it would be commendable and highly proper if the directors of our horticultural societies would bring this subject to the attention of our legislators. [This was written before the Legislature appointed a Horticultural Commission.—AUTHOR.] There might and ought to be some legislation providing for the compulsory eradication of this parasite from the orchards of California. There will always be some easy-going owners of orchards that will be slow and slovenly in their treatment of this scourge; this will at least have a tendency to retain it among us for a considerable time.

For the eradication of the scalebug Mr. Ellwood Cooper, of Santa Barbara, recommends and uses a strong decoction of tobacco, heated to about one hundred and thirty degrees, and applied by means of a force-pump worked by hand. Two acres of tobacco will supply leaves enough for any ordinary orchard, and one good drenching every year is sufficient to prevent any damage.

A correspondent of the *Florida Agriculturist*, writing from Lake George, says one of his trees that was covered with the red scale, a tree six years old, looked as if it had been scorched in a hot fire, and he supposed it was past all hope of recovery. Extreme cases prove the remedy, and he determined to try it, though with little hope of success. He boiled an ounce of fine-cut tobacco in a gallon of water till the strength was extracted,

strained off the water and dissolved in it an ounce of sulphate of iron. With a hand-brush he applied the solution to the stem and larger limbs, and with a syringe thoroughly sprinkled the leaves and branches. In a week not a living insect could be found on the tree, and at the time of writing it was as thrifty as any he had.

C. V. Riley, of Washington, D. C., advises syringing the tree with a mixture of about one part of kerosene to twenty or thirty of water, kept well mixed. He says care must be used not to get too much oil, as it may injure the tree if used too copiously.

Some growers use a mixture of blue vitriol and soapsuds.

Wm. H. Ashmead, of Jacksonville, Florida, writes that, from specimens received at different times, there would seem to be three broods, if not more, during the year. The first brood probably hatches in May, the second from the last of July to the second week in August, and the third from the last of September to the first week in October.

DESCRIPTIVE.

*Eggs.*—From eighteen to thirty under each scale, less than one-hundredth of an inch in length, ovoid, smooth, not quite twice as long as broad, of a bright yellow, promiscuously inclosed in body-walls of dead female.

*Larva.*—Length of body less than one-hundredth of an inch, nearly twice as long as wide, *bright* yellow, ovoid, much wider towards head, being widest at thoracic segments; two very short anal setæ, hinder margin rough from numerous small fleshy tubercles, with a few short hairs around margin, no indentations as in *ceroplastes rusci;* antennæ six-jointed (not easily made out with his microscope, which is of a low power); basal joint short and stout, nearly as wide as long; joints two and three less wide and of equal size; joints four and five about equal, each longer and thicker than two and three together; joint six much thinner, ending at the tip in two long hairs, the inner being the longer; an inner and outer hair on the basal joint, with two inner and two outer ones on joints above these; legs ending in a feeble claw and four digitali, the two upper being the longer; femora thickly swollen, with a distinct lobe

near base, from which a sharp spine issues. He has never noticed this in any other scale insect.

*Female Scale.*—Form round or circular, flattened slightly, rising towards center; of from a reddish to a blackish-brown color, paler at margin; measuring from four-hundredths to twelve-hundredths of an inch in diameter; in the center is a slight depression, in larger specimens two-hundredths to three-hundredths of an inch in diameter, and of a bright golden yellow, with a small brown cap.

REMEDY.

He says Mr. G. M. Holmes, of Orlando, Orange county, Florida, wrote to him, forwarding him specimens of the *Chrysomphalus ficus* (the red scale). He keeps his trees in very healthy condition and thrifty growth, as he has a large drove of cattle, and can cow-pen them. In his experiments for the removal of the red scale he had been most successful in the use of strong brine of salt and water, applied twice at intervals of two weeks. It is heroic treatment and takes the leaves off, but the scale comes with them, and if done just prior to a growing season, they soon send out a luxuriant new growth, and seem more healthy than before. He thinks potash mixed with salt and water would be an improvement.

Mr. G. B. Grandin, of this county, has been experimenting with bisulphide of carbon as a remedy for the red scale. Mr. Grandin uses the remedy under a tent. (I believe there is a patent on this method.) I understand that the results with this remedy, applied in this manner, have been somewhat varied. Some think it will be effective, while others are doubtful.

There is no other insect or parasite of which I have any knowledge that attacks our orange trees; hence I close this chapter with the admonition, watch your trees closely and diligently, and remove every appearance of evil from your orchards, which evil is, *the advent of the red and the white scalebugs.*

# CHAPTER XVI.

## Enemies—Protection, Prevention and Cure.

The gopher and the rabbit are the principal enemies with which we have to contend.

The rabbit preys to a very considerable extent only on orchards in isolated localities. It barks the trunks of the trees. They are sometimes quite destructive, and their depredations have been serious. A good shotgun in the hands of a skillful sportsman partially cures the evil. Some resort to wrapping the trunks of the trees a sufficient distance from the ground with paper or cloth. Both of these methods are unsatisfactory in their results. The wrapping of the trees is somewhat expensive in the matter of time, and the trees must suffer somewhat in consequence of being continually tied up. The best preventive known is a simple and cheap one, within the reach of all. It consists of blood and water applied to the bodies of the trees. The scent of blood is offensive to rabbits, and they never injure a tree so treated. This application can be made with a brush or cloth. The operation may require repeating once in about four or six months.

The gopher, unlike the rabbit, is not driven away by cultivation and the planting of orchards. He persists in working for his living, notwithstanding the presence of man. This little rodent is indigenous to California and to nearly all of that portion of the United States lying west of the Mississippi. It is a grievous pest and a destructive element to the horticulturist in this country. It asks no favors, but, heedless of consequences, it usually barks the roots of a tree first, then comes to the surface and gnaws the bark from the trunk of the tree for a distance of about six inches above the ground. The first intimation the

owner has of the death-dealing process going on among his trees is the barking of the tree above the ground. The tree receives its death wound long ere this; the roots are already stripped of bark, causing a slow but certain death. A tree seldom recovers from their ravages. An orange tree will retain its foliage quite green for an indefinite length of time after the bark has been nearly or quite all removed from its roots. Sometimes a year elapses after the gopher has done his work before the leaves turn yellow and fall. Attempts have been made to cure gophered trees by banking earth around the affected part. This rarely, if ever, saves the tree. It is best to dig them up and plant others in their stead.

Flooding the ground completely two or three times a year destroys large numbers of them. Land so flooded suffers little, if any, from them. It is seldom that other means of destroying them are necessary when an abundance of water can be had. If water cannot be had in sufficient quantities to flood the ground, trapping and poisoning must be resorted to.

If trapping be well done and followed up industriously, it reduces their numbers very perceptibly; but poisoning is the best and surest remedy. Cut potatoes or other vegetables into cubes each side of which will be about half an inch in length, or take short pieces of potato-top, tomato-vine or pea-vine. With the point of a small knife-blade insert in each piece the least possible quantity of crystallized strychnine. Go over the orchard, and where fresh gopher mounds are found dig to the main runway, which is generally a foot or two from the mound. Put a piece of the poisoned material (sometimes more are necessary) well into the run-way, cover the excavation and the job will be done. Some sharpen a small stick or a twig, insert the sharpened end in the poisoned material, then put it into the hole. Raisins are sometimes used in preference to vegetables. It requires only a few months in which to rid an orchard of these destructive rodents.

# CHAPTER XVII.

## Age at which an Orange Orchard will begin to Fruit.

This is a question that can be modified, to a great degree, by a number of contingencies, among which the following may be mentioned: Cultivation, irrigation, seedlings, buds, varieties of buds, location of orchard, method of planting and pruning, and fertilizing.

Proper cultivation and irrigation are the foundation on which rests the result of early fruiting. A small, dwarfed tree is unsatisfactory, even when fruiting, both the crop and the fruit being small. A tree must have size, strength and vigor when fruiting to produce a paying crop; hence the preceding chapters on cultivation, irrigation and fertilizing should be carefully considered to obtain fruit in the shortest time. The pruning must simply be well done and in due time. Seedlings usually begin to fruit the seventh or eighth year from the seed, or in four or five years after planting an orchard. Budded trees, of selected native varieties, are but a trifle in advance of seedlings. Trees budded with some foreign varieties, notably the Navel, Garey's Mediterranean Sweet and the Malta Blood, if budded on two or three-year-old roots in the nursery, are in prime condition for transplanting in two or three years thereafter, and will fruit at once. It is best, however, to remove nearly all of the fruit for the first two or three years. The gain in the growth of the tree more than compensates for the loss of fruit.

It will pay to thin out fruit to a reasonable degree annually, or every bearing year. The exact quantity of fruit to be allowed to remain on the trees must be governed by good judgment and experience. If properly reduced in quantity, the quality will increase in a corresponding ratio. A tree fifteen years old, and

producing two thousand specimens of fruit, will be more remunerative if one-half of the fruit, and probably two-thirds of it, be removed at the time of setting or very soon thereafter; besides, fine-flavored fruits will build up a reputation in the markets of the world, while small, sour fruit will ruin one. Allowing the tree to mature all the fruit that sets has a direct influence on the constitution of the tree, dwarfing it amazingly, and perhaps permanently in some instances.

Seedlings are in full bearing when they are from twelve to fourteen years old. A budded orchard of the earliest fruiting varieties will bear abundantly and remuneratively when the buds are six or seven years old. At what age they attain their best bearing condition is not known here, as our budded trees are all quite young.

It is safe to say that a seedling orchard of ten-year-old trees will, at present prices, pay all expenses and net the owner a fair marginal profit. Budded trees will do the same at five years from the bud, if budded on three-year-old stocks. The yield thereafter increases with surprising rapidity.

# CHAPTER XVIII.

## Profits of Orange Growing—Ten Acres Enough.

Nature has done for California all that can be asked for in preparing the best conditions for orange growing. Our soil is deep and rich and easily tilled. It is naturally underdrained and, as a rule, has little hard-pan to contend with; no trees to remove, no brush or undergrowth to clear away, no bogs to drain—clean as a prairie and ready for the plow. This is the general rule, to which there are, of course, some exceptions. Our trees are healthy and vigorous, productive and long lived; our fruit is superb, possessing good keeping qualities; our climate is healthy and amply temperate in many localities for the perfect success of the business. Our lands are cheap at present. The herd law protects our orchards in the southern part of the State, without the expense of fencing. Our markets are unlimited at remunerative prices. What more can we ask for, and to what country can our Eastern brethren and foreign cousins emigrate in which the inducements are more inviting, and the chances for success are more abundant than in the sunset land of beautiful California?

Hundreds of thousands of dollars will come hither ere long, in exchange for our citrus products. We shall then be a truly prosperous and wealthy people.

That the proof of the profits of orange growing may be made clear, the following, from the pen of Mr. Shorb, is appended:

"By very careful estimates made in 1874 of the crop on an orchard of four hundred and sixty-three trees, three hundred and nine of which were twelve years old from the seed, the others being too young to bear, I obtained as a net result, over and above the cost of transportation to San Francisco, com-

missions on sales, etc., twenty-two dollars and fifty cents per tree, or an average of fourteen hundred and thirty-five dollars per acre.

"I do not claim this as an average crop or result, but I do think that with proper care and attention the average can be made to equal one thousand dollars per acre, on trees twelve years of age. I have seen on our property trees yielding more than three thousand oranges per tree, which, sold at twenty dollars per thousand, would give per acre a result of four thousand one hundred and forty dollars. The average price throughout the county for the past five years has been between twenty and twenty-five dollars per thousand to those who have shipped their fruit. They will be likely to exceed this sum the present year. I see no reason to doubt that the market will remain the same for many years to come."

This statement shows what oranges brought in 1874. Mr. Shorb's prediction that the market would remain the same for many years to come has thus far been fully realized. I find, from a careful examination of San Francisco prices current for the season of 1877–8, that the average price of Los Angeles oranges was twenty-two dollars and fifty cents per thousand. In the interim between 1874 and 1880, the price for any season has not averaged less than the above figures, except for the season of 1878–9, when prices ruled lower, owing mainly to the smallness of the oranges, caused principally by over-bearing.

At the Citrus Fair held in February, 1880, at the thriving settlement of Riverside, in San Bernardino county, California, Mr. Shorb said his profits for the season of 1877–8 exceeded one thousand dollars per acre. The present season, 1879–80, prices have ranged from ten to sixty dollars per thousand for oranges delivered in San Francisco, the prices being governed by the quality of the fruit. These prices bring the average higher than that received in 1874.

The Riverside *Press* says Mr. H. M. Beers, of Riverside, has on his block a tree that bore sixty oranges two years ago, the tree then being nine years old. Last year it bore five hundred; this year two thousand oranges were by actual count sold from that tree, at an average price of thirty-seven dollars per thou-

sand, making the snug little sum of seventy-four dollars from one eleven-year-old tree.

Seventy-five seedling orange trees or one hundred and nine budded trees are usually set on an acre. Seedlings eleven or twelve years old can be relied on to produce one thousand oranges each, and budded trees the same number annually per tree at eight or nine years of age; *provided*, the buds were *first-class* when set, and both buds and seedlings had proper conditions.

If oranges were sold at five dollars per thousand to dealers who would receive them on the trees, an orange orchard would even then be handsome property. One hundred and nine budded trees, averaging one thousand per tree, at five dollars per thousand, would yield a revenue of five hundred and forty-five dollars; seventy-five seedlings per acre, at the same price, and with the same average yield, three hundred and seventy-five dollars.

By referring to Chapter XX., it will be found that an orange orchard can be brought to a bearing and self-sustaining condition for one hundred and twenty-five dollars per acre, cost of land included. Here we have an investment of one hundred and twenty-five dollars per acre returning an income of five hundred and forty-five dollars on budded trees, which income, at the handsome rate of twelve per cent. per annum, brings the orchard up to a value of more than four thousand five hundred dollars per acre; or, if seedlings, three thousand one hundred and twenty-five dollars. From these estimates there should be deducted from the value per acre of the orchard six hundred and twenty-five dollars, leaving more than three thousand nine hundred dollars as the value of an acre of budded trees in orchard, and two thousand five hundred dollars for seedlings. Six hundred and twenty-five dollars, at twelve per cent. per annum, yields seventy-five dollars interest. This is more than enough to pay all expenses of cultivation.

While the author was delivering a lecture on the subject of orange culture in California before Raisina Grange, Central California Colony, August 3d, 1878, he said:

"The first question to be examined lies at the foundation of

all business enterprises: Will it pay? I believe it will pay, and in support of this belief I shall proceed to give some data in proof of my assertion. An orange grove in full bearing in Los Angeles county can scarcely be purchased at any price. While nearly all kinds of property, over all our country, have perceptibly depreciated under the pressure of hard times, the value of orange groves remains firm and unchanged. *No one wishes to sell an orange grove; few are able to buy; it takes a fortune to purchase one.* An orchard grove is a bank in which deposits are safe beyond question, and whose dividends are regular, munificent, and we may say princely."

The income from an orange grove is the result of safe, judicious, honorable and ennobling investmeut; it is continuous in its operations, resting neither day nor night. The crop is seldom, if ever, a complete failure; the fruit is always in demand at remunerative prices.

## TEN ACRES ENOUGH.

Up to the present time I have had no reason to change my mind. We see from the above that a ten-acre orchard, which all that try can secure, is a fortune, and that it places a family in independent circumstances.

Ten acres of budded trees nine years old will return an income, at the foregoing nominal prices, on the gross sum of five thousand four hundred and forty-five dollars per acre, the trees being set in the regular order and twenty feet apart each way; or, if seedlings be preferred and set twenty-four feet apart, nearly three thousand eight hundred dollars per acre, at eleven or twelve years old.

To the orchardist who does his own work, which he can do and still have time enough for social and mental culture, one or the other of the above sums would be received by him for his labor.

This shows conclusively that orange growing in California is a very lucrative business. Even if the yield be only five hundred per tree, instead of one thousand, their income will be ample. Who of our farmers makes one-half of either of the above sums, without hired help, as can be done in the pleasant

business of orange growing? I firmly believe the above estimates can easily be realized; but those who buy scrubby trees, stake them out in unsuitable localities, and leave them to subsist on the "meager charities of a heartless world," may not become millionaires on account of their orange products.

# CHAPTER XIX.

## Picking and Packing.

The methods of picking our fruit and packing it for market have been of a character somewhat primitive until very recently. The fruit has been ruthlessly jerked from the tree, and poured into boxes containing about two hundred oranges of average size, and the lids nailed on, without any grading or packing of the fruit.

Within a few years some of our most progressive growers have paid some attention to grading, and, fortunately for many others, necessity is forcing it upon them. Step-ladders and long plain ladders are used in gathering the fruit that cannot be reached from the ground. The operator uses an open basket or a sack with a hoop in the mouth, and, if the trees be seedlings, a pair of thick, strong gloves, to prevent the thorns from puncturing the hands. The fruit is usually removed by a quick, peculiar, side-like jerk. Few specimens refuse to part from the stem without injuring the fruit if picked in this manner. The fruit, if damp, should be dried a few hours in the sun, or otherwise, before packing, that no superfluous moisture may remain on them when placed in the packages for transportation. They should be carefully sorted, making three grades of them, and should be placed in layers in the packages; they will then present a uniform and inviting appearance when opened. All orchardists should provide a brand for their packages; this would compel the producers to strive to excel in the quality of the fruit sold in such branded packages; it would also build up a reputation for superior brands of fruit. The boxes should be made of good, seasoned material, and with plenty of openings for ventilation. The brand should be placed conspicuously on the end

of the box and the marks of the consignee immediately under it. It will pay to have an eye to neatness as well as utility.

Slovenly culture, slovenly picking and packing for market will soon be at a very great discount, and he who persists in them will either be forced out of the market, or compelled to take a beggarly remuneration for his product, as a penalty for his sins of omission and commission in this business.

# CHAPTER XX.

## Cost of Planting an Orange Orchard in California and Conducting it to a Paying Basis.

Immigrants arriving in our country and desiring to invest in lands for the purpose of orange growing, need reliable information in regard to the probable cost of planting an orange orchard and conducting it to a self-sustaining condition, and the capital that will be required. The following estimates are made for their benefit, the price of land being the present ruling price for the best quality of land in desirable localities.

ESTIMATE OF THE COST OF A TEN-ACRE ORCHARD.

| | |
|---|---|
| Ten acres of land @ $50 | $500 00 |
| Ten hundred and eighty-nine budded trees (set twenty feet apart) two or three years from the time of budding, on five-year-old roots, @ 25c | 272 25 |
| Preparing and marking the ground for planting, and digging the holes | 55 00 |
| Planting the trees at 2c. each | 21 78 |
| Irrigating four times during the season, cost of water included | 40 00 |
| Cultivating seven times during the season | 70 00 |
| Total cost of land, trees, planting, etc., cultivation and irrigation the first year | $959 03 |
| Second year, cultivation and irrigation | 110 00 |
| Third year, " " " | 110 00 |
| Add for incidental expenses | 70 97 |
| Grand total at the close of the third year | $1,250 00 |

Which is one hundred and twenty-five dollars per acre.

(The foregoing was written in the spring of 1880. The price of trees was then very low. At the present time—February, 1881—there are few good trees of any kind in the market, and no orange trees worth setting and of the ages herein mentioned can be purchased for less than from fifty cents to one dollar

each. Good orange lands have also appreciably advanced in price, and the range is at present from fifty to one hundred dollars per acre in Los Angeles county.)

If the orchard be properly managed, probably the fruit it will produce the third year will pay the necessary expenses of the season. A handsome income from the investment may be relied on the fourth year.

# CHAPTER XXI.

## Our Markets, Present and Prospective — Overproduction Considered.

Markets for our orange products lie at the very foundation of the business, and are *the* desideratum of the future. Without an encouraging promise of demand the stimulus to production will practically cease.

Little needs to be said of our orange trade in the past; the demand has been in excess of the supply, as will hereafter be shown, at very remunerative prices. Our markets were, at the same time, confined to the Pacific States. These markets have been ample; even now our surplus does not fully supply the markets so easily reached. The time is fast approaching, however, and is almost at hand, when a wide range of distribution will have to be sought. Hundreds of thousands of trees are already set, and in a few years their product will amount to millions of boxes of fruit, requiring whole trains of cars or fleets of vessels to transport them.

Our past experience in orange culture has been extremely gratifying; our present is no less encouraging, and our future prospects are rich in tangible promises of bountiful reward.

### OVERPRODUCTION CONSIDERED.

There are several items that enter largely, as controlling factors, into the probable continuous demand for our orange products at remunerative figures.

I hold that orange culture will never be overdone in this country; that all our superior oranges will be taken as fast as produced, without any material reduction in prices. It is necessary to consider, in this connection, the area adapted to suc-

cessful orange culture; and when I say "orange culture," I wish to be understood as including "lemon culture" also. We are aware that the area is, indeed, limited, it being not more than a ten-thousandth part of the arable land of the State, and it may not be more than a fifty-thousandth part. Only a small portion of this limited area will produce the best specimens of citrus fruits. This is now known to be true in Southern California. The culture is as yet in its experimental stage in the central and northern parts of the State; but only small portions of those parts can produce the fruit successfully. There is no chance for the oranges produced in one section of the State to come into competition with those of another section. First, because there is a demand for all that can be produced; and, second, because they ripen several weeks earlier in the central and northern portions of the State than in the southern.

Dr. J. R. Crandall, a distinguished pomologist of Auburn, Placer county, is reported by the San Francisco *Call* as saying there can never be any rivalry between Los Angeles county and the northern counties in which semi-tropical fruit is grown, because the oranges of the latter counties mature six weeks earlier than those of the former, and are out of the market before the Los Angeles fruit comes in.

In Ohio and other States contiguous thereto they have been planting uninterruptedly, for scores of years, orchards of fruits adapted to their climate; yet the demand there for nursery stock increases annually. The inference is that the orchards must pay; that orchardists must be able to dispose of their fruits to advantage, or the markets would be filled to repletion and would be glutted, and that the planting of new orchards on a large scale would cease. Nearly all the States of the Union compete with one another in a greater or less degree in producing these varieties of fruits. Notwithstanding all this, the demand for temperate-climate fruits continues unabated. On the other hand, the area of the United States adapted to orange culture is almost nothing in comparison with the area adapted to other fruit culture, and the danger of overproduction of citrus fruits becomes a mere phantom, having an existence only in the minds of the more timid of our inhabitants.

Frank A. Kimball, of National City, San Diego county, says any one who has made the experiment knows that an orange, lemon, lime or olive tree can be raised as easily as an apple, pear or plum tree. The orchardists of Northern California and Oregon are anxious to sell us the latter fruits in perfection and endless variety, at a low price, and are willing to pay us from three to five times as much for our fruits; for nature has barred their production in that latitude. Then why not exchange the productions of the sections, when such natural benefits as commerce always brings can be secured?

I have compared only the more prominent of the semi-tropical with the corresponding northern fruits; but the same arguments that apply to them will also apply to a long catalogue of agricultural and horticultural productions. Can success be expected if a man persist in cultivating a fruit tree that will net him only one dollar per annum, when another tree could be planted that would net ten or even twenty dollars?

It is true that most of the northern fruits are raised without difficulty in all the southern counties of the State, and in quality equal to that of the best; but the profits to be derived from them bear no comparison to the results obtained from the catalogue furnished by nature for this climate.

I would say to the beginner, allow nothing to distract your attention from the plain dictates of common sense. Do not talk about overstocking the markets while we are importing large quantities of semi-tropical productions. Plant the best varieties of the kinds you intend to cultivate, bearing in mind the fact that uniform quality, symmetrical form, pleasing color, and, just now, fruits of large size, command the markets. Superior excellence, however, regardless of size, will yet command respect.

Another prime factor, so far as California is concerned, and one that enters most conspicuously into this subject of over-production, is the impetus the great and overshadowing interest of grape culture has recently received. This interest promises most encouragingly to be permanent in its ample remuneration. This has, to a great degree, attracted and diverted the attention of pomologists in the direction of grape culture, to the almost

utter abandonment of the extension of orange orchards—so much so that the demand for orange trees the present season (1879–80) has fallen off to an alarming extent, the demand being insufficient to enable semi-tropical nurserymen to make expenses, and the business of raising orange trees is languishing. (See Chapter XX.) The consequence is that large tracts of land eminently adapted to successful orange culture are being planted, or reserved for planting, to vineyards.

The subject of overproduction appears most shadowy, indeed, when carefully examined.

If it ever happen that our citrus products crowd the markets and reduce the prices, the consumption will rapidly increase, soon relieving the markets of their surplus and establishing an equilibrium. Oranges are now a luxury, and even here, where they are produced, poor people cannot afford to buy them. Only the rich can enjoy their health-giving properties. The middle classes, that constitute the mass of our population, cannot touch them at ruling rates.

Our population is rapidly increasing—perhaps in a greater ratio than our orange orchards and their productions—a fact that must not be overlooked by the investigator of this subject.

The question of transportation enters largely into this subject. It requires no prophet to predict that the increase of railroads and other means of transportation will continuously transcend the volume of our productions. When competitive railroads that will span the continent below the snow-belt shall have been completed, a new era will dawn upon us; our luscious fruit will then find its way to all portions of our country. The day is not far distant when orders for whole cargoes of oranges will be received from across the Atlantic. We enjoy, also, a decided advantage for the marketing of our oranges, not enjoyed by other citrus-producing countries—in the extraordinary keeping qualities of our fruit, and in the great length of time from the commencement of its ripening to its full maturity. They begin to ripen and are marketable in December, continuing to grow more delicious till July, allowing fully eight months in which to market them. This is, I believe, a peculiarity and advantage not enjoyed by any other known orange-growing country. They

can be allowed to mature fully before picking and still be in perfect condition, and they will keep long enough to bear transportation to the most distant markets. In all other countries they have to be picked green, or in a semi-green condition, to be carried successfully to remote markets. Ours will keep sound, when theirs, under the same conditions, would decay. Ours can be ripened on the trees and will then keep for months; theirs must be shipped in an almost green condition, or not at all. To pick a green orange is to do so at the expense of its flavor; it will be tough and stringy, or will become so, and it will be accompanied with a flat, insipid taste, always prevalent with the Tahiti oranges of our markets.

The peculiarities of our climate—cool nights, absence of rain during eight or nine months of the year, and the consequent general dryness of the atmosphere—prepare our oranges by a natural process, while yet on the tree, for great keeping and shipping qualities.

The New York *World*, speaking of oranges, says: "To say the fruit is perishable, as usually understood, is but an inadequate expression of the extent of that risk. No other production is so perishable. Of about two hundred millions of oranges received here last season—from September until March—nearly eighty millions perished; or forty per cent. of those received from Mediterranean ports, and forty-six per cent. of those received from the West Indies. The loss on a cargo of two hundred thousand oranges from Dominica was one hundred and fifty-nine thousand six hundred, or seventy-nine per cent.; on eleven cargoes from Mayaquez, comprising two millions six hundred and fifty-four thousand five hundred and ninety oranges, one million four hundred and five thousand one hundred and twenty, or fifty-three per cent.; and on a cargo of two hundred and thirty thousand from Ocho Rios, two hundred and ten thousand, or ninety-one per cent. In many cases the amounts received from sales of cargoes were insufficient to pay for charters of the vessels."

In the event of an emergency, when prices rule too low, the surplus can be profitably converted into wine or brandy, for which there will probably be an unlimited demand.

In corroboration of these statements relative to the keeping qualities of our oranges and of other points, the following is quoted from the writings of Mr. J. De Barth Shorb, an extensive pomologist of San Gabriel, Los Angeles county:

"The area upon which this culture can be successfully followed is necessarily limited; the population and consumption in this State and adjoining States and Territories are rapidly increasing each year; new markets are opened to us through the energy of the Southern and Central Pacific Railway Directory in extending their lines; and therefore I think the consumption will keep pace with the production and sustain the present market price. Another and most important reason to sustain this opinion rests in the fact that on this coast the oranges *remain on the trees, without decay, for a period of at least from four to six months after they are matured*, thus giving us that period to ship in, while other orange-producing countries are compelled to ship their fruit as soon as it is matured and sometimes before; hence the demoralized condition of the orange market, at certain seasons, in our Eastern cities. While other countries are compelled to gather their entire crop in a very limited time, we may supply the market only as fast as the consumption will warrant. Our oranges are remarkable for their good keeping qualities when packed for market. I am indebted to Mr. Wm. Pridham, of Los Angeles, agent for Wells, Fargo & Co., for the following statement establishing this fact: 'Eight boxes of oranges were gathered and shipped from my orchard about the last of March, 1875, to Wells, Fargo & Co.'s agents in London, Messrs. Iris and Albin. They were shipped to San Francisco by steamer, thence overland to New York, thence by steamer to Liverpool, where they arrived in perfect order and condition, not one being decayed, and gave so general satisfaction that another shipment has been made lately to the same destination, and, I hope, with similar results.'"

The following is from a letter to the author by F. M. Shaw, of Los Angeles:

In the season of 1873 4 he took two boxes of oranges to New York via Panama, being thirty days in making the trip from Los Angeles. Specimens of the oranges and of other fruits he

took with him were placed on the table of the agricultural editor of the New York *Tribune*. The fruit looked almost or quite as fresh as on the day of his departure, and elicited a handsome editorial relative to the fruit and the place of its production.

The delay in New York made the time to Europe forty-nine days—forty days through tropical heat—before the last of it was used. No especial care had been taken to preserve the fruit, yet none had decayed and been thrown out.

It was almost incredible to the ladies and gentlemen who partook of the full-flavored and nice-looking oranges in Londonderry, Ireland, and Edinburgh, Scotland, that the delicate and luscious samples had come nine thousand miles, and had been seven weeks in transit, but the fact was indisputable.

The following tribute to the excellence of the oranges raised by Mr. L. J. Rose, an extensive horticulturist of Sunny Slope, Los Angeles county, is from the New York *Evening Post:*

"Messrs. Perkins and Stern, who deal in California wines, have sent us a sample of another product of that fertile region, namely, of the oranges raised at the Sunny Slope plantation at Los Angeles. [San Gabriel Mission, eleven miles east of the City of Los Angeles.] They are of remarkable fineness, and of a flavor which, without possessing the saccharine sweetness of the Havana oranges, is even more rich, and, in consequence of the blending of its sweetness with a little acidity, is more agreeable. In comparing it with the Indian river orange from the eastern shore of Florida, it is perceived that it is a little inferior to it—not in the flavor of its juices, but in this peculiarity: the Indian river fruit has the membranes and cells of the inner part of a more delicate texture, and which are more easily broken by the teeth, so that no part is rejected even by the most delicate masticator. We may boast that the world produces no finer oranges than the United States. The Bildah orange, in the northern part of Africa, has a great reputation, but it is not so fine as the Indian river orange. The oranges of Tyre, of Sidon and Jaffa are peculiarly fine in size and quality, but they do not excel, in either respect, those of Los Angeles."

From the *Semi-Tropic California*, Chas. R. Coleman, editor.

NEW YORK, May 26, 1881.

DEAR GEORGE: The barrel of oranges you shipped me on March 25th arrived here to-day. Owing to delays caused by the recent floods in the West, the fruit has been *sixty-one* days coming here. Of course I expected to find the oranges all rotten after such an exceptional long journey, but I was agreeably surprised to find that out of the three hundred and twenty-six oranges which the barrel contained only nineteen were partly decayed. I carefully examined the fruit in the presence of several gentlemen, who can testify to the above. The fruit has a fine flavor, and many of our friends and others to whom I have given some of the oranges have pronounced them the finest they ever tasted. I was myself much surprised to see so fine large fruit. As to the 'keeping qualities' of California oranges, I am convinced by this experiment that your fruit can be successfully shipped to all parts of the world. Your Brother,

HERMAN.

These oranges were exhibited at our Citrus Fair, March 18th, by George Muller, of Pasadena, and after being on exhibition for more than a week were shipped to his brother in New York, who sends the above letter. It may be said farther that the oranges were very poorly packed; they were quite loose in the barrel, which probably accounts for the few rotten ones.—ED.

ORANGES IN MASSACHUSETTS.

A gentleman writing from Massachusetts, June 4th, says: The oranges you gave us in Los Angeles were just splendid; lasted us clear through, and I have some now to see how long they will keep. The clusters hung to the limbs nearly all the way home, and I think they would all the way if I had not taken them out so many times to show them. They are nearly as fresh as they were the day you gave them to me, which was the 28th of March. Taking into consideration the length of time they have been picked (over two months), and the way in which I brought them home, in a valise, knocking around everywhere, I think this settles the question about shipping oranges from your valley. Mr. H. kept some of them in a window on Merrimack street over two months, and several persons tested them and pronounced them superior to Florida oranges.

More than a year has elapsed since the greater part of this work was written; it is now November, 1881. To avoid the imputation of being one of the "false prophets of the last days," this being the year in which the final winding up of earthly accounts would take place, according to some widely-circulated predictions, it is necessary for me to state the causes, so far as I may be able, that made oranges a drug in our markets during a considerable portion of this year.

First—An unusually severe freeze in the early part of last November and subsequent cold weather made our oranges small and sour—sour until warm weather late in the season, when other fruits supplied our markets.

Second—Heavy and long-continued rains in the central and northern portions of this State, interrupting transportation to all of the northern and central parts of the Pacific slope of the United States.

Third—The increased production over that of former years called for an eastern outlet on reasonable terms, in order to secure remunerative prices. The two great railroads now composing the "Southern route" between the Missouri river and the Pacific, formed a junction in the spring of this year. For a number of months after the union of the two roads neither company would give bills of lading for freight over the other company's road; hence orange shipments to the East were often attended with dissatisfaction, and sometimes with pecuniary loss to the shippers.

The hostile feelings of the railroad magnates have calmed down sufficiently to admit of through shipments, and it is to be hoped that before the present crop of oranges will be ready for shipment the very favorable terms now offered shippers of raisins will also be accorded to shippers of oranges. When this shall have been done, I predict a golden future for our intelligent and energetic orange-growers.

# CHAPTER XXII.

## Where Can Orange Trees be Successfully Grown in this State?

A knowledge of the degree of cold an orange tree can endure without serious injury is required to answer this question. Orange plants, when young, are very tender and susceptible to frosts; but as they grow older they become more hardy, and adapt themselves without injury to a degree of cold that is truly surprising. It was thought for a long time that Southern California was the only part of the State sufficiently free from frosts and freezes to be adapted to successful citrus culture. But it gradually became known that many portions of Northern and Central California are sufficiently free from severe freezes to enable them to raise oranges, by protecting the trees from frosts till they attain the age of five or six years. In the most favored parts of the districts mentioned the raising of oranges can be made a success. Lemon trees are more tender than the orange, and the lime more tender than the lemon.

I would advise those who plant in the districts referred to not to plant trees less than four years old, and five-year-olds will be still better; then, with proper management, which will include protection in the winter, and possibly till the middle of April, their orchards will be hardy enough in a few years to withstand the severest freezes in those portions of the State.

The winters of 1878–9 and 1879–80 were unprecedentedly cold; nothing to compare with them has occurred since the occupation of this country by the United States. In many places, even in this county, the trees in nurseries and young orchards suffered severely on low lands. The damage to citrus trees was reported to be so general that the proprietors of the

San Francisco *Bulletin* issued a circular letter in February, 1879, and sent copies to prominent horticulturists throughout the State. Responses came from sixty-nine persons, representing thirty counties, ranging from Shasta in the north, to San Diego in the south. No better plan could have been adopted for ascertaining the degree of cold experienced in various parts of the State. These letters are, in my opinion, of inestimable value; I shall therefore reproduce them here.

Editorial remarks of the *Bulletin* at the time of publishing the correspondence:

"If the palm merits the title of 'princess' of the vegetable kingdom, the orange deserves to be called the prince of fruit trees. If considered with reference to its dark, glossy, evergreen foliage, the luscious flavor of its golden fruit, or the ravishing perfume of its delicate snowy blossoms, it must be granted the highest rank among all the trees that minister to the wants of man. Those regions in which this 'golden apple of the Hesperides' flourishes are favored by nature far beyond all other portions of the earth.

"California is one of those chosen spots, and its fortunate inhabitants may now rest in the assurance that this noble genus of trees can be successfully cultivated almost from one extremity of the State to the other. This winter, which all agree has thus far been one of the severest on record, has afforded the opportunity to determine, probably for all future time, the claims of many localities in the central and northern parts of the State to be included in the orange-growing belt. In order to take advantage of this opportunity a circular letter of inquiry was sent from this office to one or more cultivators of orange trees in each county. Nearly all have kindly responded, and we are now able to lay the aggregate result before our readers."

CIRCULAR LETTER.

First—What were the lowest readings of the thermometer in your neighborhood during the recent cold term, giving, if possible, the lowest temperature among the orange and lemon trees?

Second—State the damage, if any, that your orange and lemon trees, or those in your vicinity, have suffered from the recent frosts, noting in what manner they are affected.

Third—In answering question number two, state whether the trees are planted on high or low ground; also their ages.

Fourth—Have the frosts of this and previous winters been sufficiently severe to preclude the successful cultivation of orange and lemon trees, without protection, in your vicinity?

Following are the replies received, and the names and locations of the writers, arranged by counties, beginning at the north:

*Shasta County*—Judge C. C. Bush, Reading:

First—Lowest readings: December 22d, twenty-four degrees; January 16th, twenty-four degrees; February 15th, twenty-eight degrees; all taken at seven A. M.

Second—There are very few orange or lemon trees in this neighborhood. I planted in January, 1878, just before a cold snap, six two-year-old grafts on five-year-old roots. They did well last year, some of them making five feet of wood. The weather this fall was so warm it started some shoots before the cold of December and January. The frost nipped the young shoots, or a part of them. The cold weather did not seem to affect the wood and leaves of last year a particle.

Third—The trees are planted on what we call high red plains, two thousand feet west of the bank of the Sacramento river and from sixty to seventy feet above low-water mark.

Fourth—I am of the opinion that this has been as severe a winter on trees as we have had since I came into the country, twenty-eight years ago this month. The thermometer may have marked lower, but this season it continued cold, windy and frosty for more days together. In Shasta a month ago the oranges were hanging nice and yellow on trees in the garden of Charles Litsch; and at Mr. Wise's, a mile this side of Shasta, the trees yesterday, February 4th, looked splendid. I have no doubt that oranges and lemons can be raised here successfully and at a profit.

*Tehama County*—L. H. De Lange, Red Bluff:

First—To the best of my recollection, twenty-five degrees above zero.

Second—The only damage done has been the freezing of the tender shoots.

Third—High and low both. One of the trees is nineteen

years old, and has been bearing for eight years; two full crops each year.

Fourth—They have not. We are having the most severe frosts this winter ever known in this section of the country. I have sold hundreds of trees, but I never knew one to die from frost or cold weather.

*Butte County*—J. B. Ketchum, Bidwell's Bar:

First—Lowest, twenty-four to twenty-eight degrees most of the time. At night, twenty-nine to thirty-two degrees.

Second—When frost strikes the leaves, they fold up and appear to be badly injured, but moist weather restores their appearance. The leaves turn yellow in part, especially on the south side of the tree.

Third—Thirty feet above low-water mark, north side of hill (Feather river). One tree twenty-four years old.

Fourth—The hardier orange tree, such as Los Angeles and Acapulco, will succeed in proper soil. In February, 1862, the thermometer stood twenty-one degrees, and although there was eight inches of snow on the ground, no injury was done to the trees. Lemon trees are injured.

*Colusa County*—L. F. Moulton, Colusa:

First — I am informed that the lowest temperature was eighteen degrees, but the greatest damage was done after that by very heavy frost with higher temperature. Ice formed an inch thick.

Second—I have two hundred and fifty six-year-old orange trees, and some lemon, lime and citron trees, on medium low ground, common soil. Leaves and ends of young twigs partly frosted, but not seriously damaged.

Fourth—I have been experimenting on a small scale for eighteen years, and think they should be protected by hedges, fences or buildings, to prevent the hot sun from melting the frost before the warmth of the atmosphere has taken it out in the morning. I also advise planting in a place sheltered as much as possible on all sides. I have one bearing tree that froze nearly to the ground in 1872, but it has again commenced bearing superior oranges this year. It has never been protected only as above stated. I have one other bearing tree which froze

so it was apparently dead; but after having been out of sight for two years its roots threw up a top which promises to become a good tree. I have others but very slightly injured growing from seed. Limes, lemons and citrons are rather tenderer than the orange.

[The *Bulletin* says two oranges mentioned by Mr. Moulton were pronounced by several persons excellent in every respect, except that there appeared to be a lack of juice, either from the effects of frost, or from hanging a long time on the tree after ripening. They were as sweet as Los Angeles fruit in April.—AUTHOR.]

*Lake County*—Thomas H. Buckingham, Clear Lake:

First—Lowest temperature in neighborhood, twenty-four degrees. This was at the level of Clear Lake. My orange orchard is located two hundred feet above, with easterly exposure, where the estimated temperature was not lower than thirty degrees. I had no test made by thermometer at the orchard.

Second—My orange trees have not sustained any apparent injury from frost. The elevation of the orchard is fifteen hundred feet above the sea level. Age of trees, part three and part four years.

Fourth—The present season is reputed to be the coldest known in my neighborhood. My trees have been planted three years, and are now doing exceedingly well, and I believe they will continue to do so. I know of no oranges in the vicinity, other than mine, but I am satisfied there are in Lake county thousands of acres on which oranges can be successfully cultivated.

*Yuba County*—J. T. Hickey, Marysville:

First—The thermometer in this city was down as low as seventeen degrees.

Second—Nearly all the young shoots are destroyed. The leaves on nearly all the young trees are falling off. I think many of the young trees will be put back at least a year.

Third—Planted on low ground. Have been planted two years, and were five years old when put out.

Fourth—This has been the severest winter on orange and lemon trees ever witnessed in this section of the country, but I

think with a little more protection oranges, etc., can be successfully cultivated in this vicinity.

Miller Bros., Marysville:

First—The lowest temperature we noticed was twenty-six degrees above zero, although we believe it to have been lower.

Second—The only damage is to the leaves and tender sprouts, but it will take some time for them to recuperate in the spring. The old trees are affected very little.

Third—Upon low ground, and seven years old. They are protected from wind by apricot trees.

Fourth—There has been no frost in twelve years to prevent the successful growing of orange and lemon trees.

*Placer County*—E. Goodrich, Newcastle:

First—Lowest, twenty-six degrees.

Second—I have seedling orange and lemon trees. One tree in bearing, at present full of oranges. The frost has not injured either tree or fruit in the least. The trees are from one to fourteen years old. My lime trees, one year old, were nipped a little on the top. The leaves on the lemon trees were of a little lighter shade after the frost, but resumed their usual color in a few days. There are a good many trees in this neighborhood.

Third—They are planted on high ground, and are not protected in the least from wind or frost.

Fourth—The frost has not been severe enough to hurt orange or lemon trees in the least, although it was more severe than at any time before for fifteen years. I am now preparing a piece of ground on which to plant an orange orchard this spring.

D. A. Rice, Newcastle:

First—Lowest, twenty-four degrees.

Second—No damage to speak of. Ends of tender shoots killed on both high and low land. Trees from two to eighteen years old

Fourth—No; not after the trees have started. I consider the orange a very hardy tree. I think as fine oranges are grown here as anywhere. Mr. Sibley, of Orange, Los Angeles county, stated that one of my raising, from a seedling sixteen years old, was the finest he had ever tasted. They can be grown successfully in the foot-hills.

Jas. M. Frey, M. D., Newcastle:

First—Lowest, twenty-four degrees Fahrenheit.

Second—My trees, over six years old, will lose some of their leaves, but they are not materially injured. Some trees, two years old, are killed.

Third—My trees are on a hill and are of all ages up to ten years.

Fourth—No. The only year in which the ground was frozen was 1854. The cold spell did not last so long then as it did this time. The frost will not hurt orange trees when the atmosphere is dry. We have fared much better than Sacramento or San José.

W. Hathaway, Ophir:

First—The lowest temperature among orange and lemon trees in this town was twenty-six degrees above zero. There are about five hundred trees in this place, old and young, mostly orange. The oldest were raised from seed planted in 1862. They have been in bearing six or seven years. Those standing on high ground are not hurt at all. Those planted in low places have the ends of the fall growth frost-bitten a little, but not enough to hurt them.

Fourth—No. These trees all stand exposed to the weather, but look strong and vigorous.

Dr. J. R. Crandall, Auburn:

Friday night, January 17th, was the coldest of the season with us at Auburn, the thermometer reading twenty-five degrees in an out-door exposure amongst the orange and lemon trees. I know of no locality in the neighborhood of Auburn showing a lower temperature.

Second—Last April I planted two hundred and fifty Sweet Rind and Lisbon lemons, and about one hundred oranges, consisting of Mediterranean Sweet, St. Michael, Duroi and the Konah, purchased of Mr. Sibley, of Orange, and represented to be two years old from the bud on four-year-old roots. Several of the Mediterranean Sweet have matured oranges. Not a leaf of any of said trees was injured in the least by frost. The orange and lemon at Clipper Gap, seven miles above us, north, are not injured by frost.

Third—My lemon trees are planted at an altitude above tide water of say eleven hundred and fifty feet; some of the oranges at say twelve hundred feet.

Fourth — I have resided at Auburn twenty-eight years. Twenty-two years ago I planted orange seed and raised several trees. Anticipating the trouble required in caring for them, I kept but one. I planted this in my garden, by constantly flowing water, intending to house it during the winter. Neglecting this, it has stood exposed twenty-one years. It has produced eight crops, the last of which, gathered on the 30th day of November last, turned out about one thousand ripe oranges. I have resided at this place for twenty-eight years, twenty-five of which have been devoted to some extent to the culture of deciduous fruit trees to but little purpose financially. I paid sixty dollars per dozen for my first apple trees, one year old, whereas had one-half the cost and labor so expended been applied to the cultivation of semi-tropical fruits, Los Angeles and its surroundings would not be the only place in California famous for its oranges, lemons, etc. I spent the most of last December visiting Southern California. I was at Los Angeles before and during the cold weather, which affected their young orange and lemon trees to an extent far beyond any injury in our region. While Los Angeles is justly celebrated as the garden of semi-tropical fruits, I return to Placer county satisfied beyond a peradventure that its hills and valleys will ere long become as famous for their semi-tropical fruits as they are at present justly famous for their deciduous fruits.

M. Andrews, Auburn:

First—Twenty-four degrees above is the lowest I have heard of, and that near a few orange trees.

Second—My trees are on high ground, and are not injured in the least. A few are frost-bitten so that they will lose a part of their leaves.

Third—Those that are frost-bitten are on high ground, and are about four years old.

Fourth—My two bearing trees have never been protected, or injured by frost, and are more than twenty-two years old. There are a few other trees here from eighteen to twenty years old that have never been protected, or injured by frost.

H. W. Hurlburt, Auburn:

First—The lowest known reading of the thermometer this winter was twenty-six degrees Fahrenheit in Auburn, and twenty-seven degrees in my neighborhood.

Second—No damage at all has been done, except in a few localities, where the leaves are killed. It is not thought that a single orange or lemon tree, even though just set out, has been killed.

Third—The high ground is the best and it is generally used. Most of the trees about here were planted last year.

Fourth—This is by far the coldest winter ever known here. The trees were wholly unprotected. There are many places here where even tomato vines flourish uninjured throughout the year in ordinary winters.

*Yolo County*—J. R. Wolfskill, Winters:

First—I cannot say, as I had no thermometer at that time. The ice was probably three-eighths or one-half inch thick several mornings.

Second—I cannot state the extent of the damage as the trees may come out all right in the spring. I think it is slight and confined to late growth on young trees. The leaves at the ends of young shoots are dried at present; this is all the damage visible.

Third—Both high and low ground. Of course the frost affects the young trees more on low ground than on high. The ages of the trees, from twenty-two years down.

Fourth—No. I have been cultivating orange trees since about 1850 and have not lost a tree by frost.

J. B. Saul, Davisville:

First—December 18th, seven o'clock A. M., thirty-two degrees; 20th, twenty-seven degrees; 21st, twenty-six degrees; 23d, twenty-four degrees; 26th, twenty-four degrees; 27th, nineteen degrees (lowest); 28th, thirty-two degrees; January 6th, thirty-two degrees; 13th, thirty degrees; 15th, twenty-eight degrees; 16th, twenty-nine degrees; 18th, twenty-eight degrees; 20th, twenty-five degrees; 22d, thirty-two degrees. All the readings were taken at seven A. M.

Second—All the annual growth on the three-year-old trees was

killed close down to the two-year-old wood, but no trees were killed. Our trees eight years old, wood well matured before winter, show no effects of the extreme cold. We have about two thousand orange trees from three to eight years old.

Third—Trees planted on deep, rich, alluvial soil, with slight fall northwardly from the banks of Puta creek.

Fourth—Present appearances of our orange and lemon trees, after having passed through a winter so unusually cold, convince me that the culture of the citrus family will be a success in the upper central portions of the State. I have tor twenty-five years been a fruit grower in this State.

*Napa County*—Hon. M. M. Estee, Napa:

First—The lowest reading of the thermometer at my farm, two and a half miles from Napa City, Napa Valley, during this winter, was twenty degrees above zero, and this was the lowest temperature among my orange trees.

Second—I have one hundred orange and six lemon trees on my farm. Orange trees more than five years old, uninjured. Trees one, two and three years old were more or less frozen. Some of the young trees will lose all their leaves; others of the same size and age, standing near by, are left unhurt. None are killed, though some of the young and tender shoots were killed—no other branches killed. My lemon trees did not fare so well. Though they are not killed, there does not seem to be a green leaf left on them. Very few of the branches are injured, yet the ends of some of them will doubtless die. The fruit on all my large trees which have any fruit is perfect and of good flavor. I think the effects of the frost will not be noticeable by the first of May.

Third—My trees are planted on land about fifty feet above the level of Napa Valley. They vary in age from one to ten years. Some of the ten-year-olds have grown on the place from seed; others have been brought from Los Angeles.

Fourth—I doubt not that oranges and lemons can be successfully grown in Napa Valley. The young trees will, of course, require protection such a winter as this; but my experience is that orange trees from four to five years old are of the right age for transplanting. Younger trees do not do so well, nor wil

they stand the frost so well. The mere wrapping of straw around the small trees will protect them, and it can be done at a slight expense.

J. Lewelling, St. Helena:

First—I am near the foot-hills and on high ground. Lowest temperature, twenty-six degrees, thermometer in porch. In St. Helena, one mile north, lowest temperature, thermometer hanging outside on a tree, sixteen degrees.

Second—My orange trees are very slightly injured. My lemon trees are badly damaged, but I do not think any of them are killed to the ground.

Third—My trees are on high ground. They are three and five years old. I have one tree about sixteen years old not affected.

Fourth—I have cultivated the orange and lemon in the valley and in the foot-hills. My experience is, that neither will grow in the valley without protection, while in the foot-hills I have not lost a tree, and do not expect to lose any, though I have not protected them in any way.

Chas. Krug, St. Helena:

First—Lowest, twenty-one degrees.

Second—My only bearing orange tree, a seedling, was considerably affected by the recent frosts, about one-fourth part of its foliage looking yellowish, and one-tenth part of the fruit being injured. The tree has been bearing for four years, and was never damaged before. Two seven-year-old seedling orange trees were not hurt at all. Of sixty-six young orange trees, three and four years old, twelve were killed to within six inches of the roots, but they will sprout again. The others have only the foliage and most of the young shoots burned, with the exception of ten, which are well sheltered by large oak trees. W. W. Lyman, John York and Aug. Beretta, in my neighborhood, report none of their orange trees hurt by frost. Their farms are on higher ground.

Third—On dry soil, low land.

Fourth—Frosts of former winters never damaged our orange trees sufficiently to preclude their successful cultivation, and everybody felt encouraged to plant orange trees; but the frosts of the present winter make success appear doubtful.

*Sonoma County*—Q. C. Smith, M. D., Cloverdale:

First—Lowest, twenty-two, twenty-four, twenty-six, twenty-eight, thirty and thirty-one degrees. Twenty-nine degrees is the lowest we have had before this winter for six or eight years past, and thirty-two degrees is as low as we ordinarily have in winter.

Second—The damage to orange and lemon trees several years old was very slight; young trees suffered more, on which the most tender exposed shoots or buds were killed, but not enough to compromise the life of the tree. Pepper trees suffered as much as orange trees or more.

Third—The above refers to trees in Cloverdale, and which are on low ground in Russian River Valley, where the frosts are more severe than in higher localities,

Fourth—No. We have raised and do raise oranges without protection. Lemons could be raised successfully in many elevated localities near this place, but in Cloverdale it is rather too cold during our coldest winters for them to thrive and bear, though they grow well here.

S. A. Marshall, Healdsburg:

First—Thermometer from twenty to twenty-six degrees.

Second—First or spring growth uninjured, but the growth the tree makes in the fall, after the early rains, is badly frost-bitten. Leaves and young growth appear scalded. Mediterranean Sweet and Konah not injured so much as Los Angeles and Acapulco. Lemons injured very little, only leaves affected by frost.

Third—Trees planted last spring on hill land, and about three years old. One Mediterranean Sweet, planted last spring, fruited; the oranges were not injured by frost. Older trees in the vicinity, and on the same kind of land, uninjured comparatively, and bearing fruit. We have the guava growing, which was planted two years ago. It is doing well, the frost not having affected it.

Col. J. B. Armstrong, Santa Rosa:

First—Mean temperature in this valley at sunrise for December, 1878, the coldest month, thirty-two and one-half degrees; December 27th, the coldest morning, eighteen degrees. In the

thermal belt, at Whittaker's, five hundred feet above this valley, mean temperature at same time, forty-two and one-half degrees; coldest morning, thirty degrees. Trees more than six years old uninjured. The leaves of some are half rolled up by the dry north winds and drouth, five and seventy-hundredths inches being the season's rainfall to date (January 21st), against fourteen and ninety-five-hundredths inches to this time in 1878. Young trees in the valley, where unprotected, are badly nipped. The leaves are killed and are falling off; so with young gum trees. Old trees safe.

Fourth—There is nothing to discourage their cultivation. Young trees require shelter every winter until they attain the age of five or six years; then they are hardy enough, even in the valley. Those protected by evergreen branches fare best. I have never lost a tree or had one injured, and have arranged to plant more; so have many others. There are trees only fifty feet higher than the bed of Russian river, and thirty miles northwardly, at Mr. Harry Kier's, now safe and sound and loaded with oranges.

February 3d Mr. Armstrong wrote as follows: "Since January 21st, when writing to you on the effects of the cold weather, I find that orange trees in the vicinity of Santa Rosa, where not sheltered from the north winds, have suffered more than those in sheltered positions. Even those, however, are in a fair condition, if of such age that the wood and bark were matured. Very young trees, on low land, are badly nipped. Orange growing is no longer an experiment here. With ordinary care they succeed."

L. P. Rixford, Sonoma:

First—Lowest temperature noted among my orange trees, twenty-five degrees, though the same night, on ground twenty or thirty feet higher, the lowest was thirty degrees. Location, near foot-hills, three miles west from the village of Sonoma.

Second—No orange or lemon trees have been killed in my vicinity, and no serious injury has been caused by frosts this winter. The only damage has been the loss of a few leaves on the ends of the young growth on the youngest trees. Trees five years old and upwards are entirely uninjured. Lemon and

Bigarde orange trees have been blooming on the highest ground since September.

Third—Both high and low ground. Not a leaf is injured except on low ground. My trees are from two to twelve years old.

Fourth—General Vallejo, on the east side of the valley, has trees twenty years old, some of which have produced two thousand oranges each. Caleb Carriger, Nicholas Carriger, Col. Rodgers and others, on the west side, have thrifty bearing trees. From the success of these cultivators, and my own experience of ten years, I am satisfied that both the orange and the lemon can be profitably cultivated in Sonoma Valley. In the lower portions of the valley frosts are more severe, and young trees will need protection during winters like this.

Morris Bros., Sonoma:

First—Before sunrise for a number of mornings it marked twenty degrees. The thermometer hung out of doors, within forty feet of the orange grove.

Second—Our trees are badly frosted and now have the general appearance of having been blighted by fire. They will recover, however, as only the tops and leaves are affected. They are growing on low ground, and their average age is seven years. I have a few growing where they are protected by other trees from the winds, which have only their new growth nipped. Some of them now have matured fruit.

This winter has been the coldest ever known here. Our trees were never hurt by frost heretofore to any extent. The orange and lemon trees on farms adjoining us, but on much higher ground, have never been touched, and are now looking as bright and green as if there had not been any frost. The culture of the orange and lemon is an assured success here, but they must be planted in the foot-hills of the valley.

*Marin County*—R. J. Trumbull, San Rafael:

First—The lowest temperature at San Rafael during the recent "cold snap" was twenty-eight degrees. In Ross Valley, distant about three miles, the thermometer indicated twenty-six degrees.

Second—No serious damage has been done in this county to either the orange or the lemon, so far as I have been able to

learn. On low, poorly-drained lands, and where they are planted in retentive soil, both have been affected, the tender shoots being nipped and some of the leaves frosted. In Ross Valley, on clayey soil, somewhat elevated but close to the Tamalpais range of mountains, the trees were more affected, but in no instance has the trunk been seriously injured. This reference is made to trees four years or more of age. At Corte Madera, two miles distant from Ross Landing, on elevated land well protected on the north, trees have shown no signs whatever of frost. In San Rafael, young orange trees (Florida seedlings), from six to eight inches high, in boxes placed on ground lower than that occupied by trees six years old which were frosted slightly, were uninjured. This may be attributed in part to the fact that these seedlings are from the seed of the sour orange of Florida, which is considered more hardy than others; but I think the light character of the soil in the seed-box, with good drainage, is entitled to considerable credit.

With care in the selection of proper soil, which should be naturally light or made light, and a location protected as much as possible from north winds, there is nothing in the way of successfully growing both the lemon and the orange inside of the Tamalpais range. Lemons and oranges of excellent quality have already been produced in San Rafael, and that, too, by persons professing to have little knowledge, if any, of the nature of the trees or the requisites of their culture.

Fourth—The severe weather of late has certainly had the effect of deterring some of the timid ones from planting these trees this season, but there is no doubt that a year hence, with the experience so valuable as this will prove, an unusual demand will be made upon our nurserymen, and it may be that difficulty will be experienced in filling orders.

*Solano County*—W. J. Pleasants, Pleasant Valley:

First—Eighteen degrees was the lowest, though several times as low as twenty degrees. This was, of course, on the lower land.

Second—The trees were planted last spring, on low land, where the thermometer read eighteen degrees. The leaves and small limbs on these trees are all killed. I have, on bench land seventy-five feet higher than that on which the young trees are,

one hundred orange trees nine years old that show no appearance of frost.

Third—My old trees are now in bearing; they have never shown the effect of cold to any extent. The thermometer, among them, read twenty-five degrees at the lowest.

Fourth—I do not think we can successfully cultivate orange or lemon trees on our low land, but on our bench land or upland, both orange and lemon trees do well, so far as my experience goes. In 1873 my orange trees were bent to the ground with fifteen inches of snow. They were not injured in the least by the cold.

W. Cantelow, Pleasant Valley:

First—The lowest point to which the thermometer fell at my place was thirty-two degrees. It hung on the north side of a shed, one hundred and twenty-five feet from the trees. My place is about six hundred feet above the sea.

Second—I have fifty budded trees, planted last year. They have been watered and they made a good growth late in the season, but not one is damaged. I saw, to-day, at Mr. M. R. Miller's place, on low ground, three-year-old orange trees that were killed by the frost.

Third—At L. W. Buck's, elevation about three hundred feet, thermometer twenty-seven degrees, he has orange and lemon trees uninjured that were planted last year.

Fourth—The frosts have not been too severe at an elevation of three hundred feet. Oranges and lemons will not be raised to any extent on the low land of Vaca and Pleasant Valleys. There were a number of trees planted in Vacaville last season, every one of which is killed, as I am informed.

C. Martell, Pleasant Valley:

First—My place is in the hills in Pleasant Valley. I did not notice the thermometer, but saw ice on many mornings, this winter and last, one-fourth of an inch thick.

Second—I have one hundred and seventy-five orange and twenty-five lemon trees. I cannot see that the frost has done them any damage at all this winter, or that it injured them any last winter.

Third—My orange orchard is about one hundred and fifty

feet above Pleasant Valley proper, in what I call a favored spot. I set out one hundred trees in 1877 and seventy-five orange and twenty-five lemon in 1878, at one year old.

Fourth—Nearly all the young orange and lemon trees in this vicinity have been damaged more or less in the valley, but not in the hills.

*Sacramento County*—Peter Hanson, Isleton:

First—I did not notice the thermometer, but saw ice half an inch thick on still water.

Second—No damage has been done to orange trees in this vicinity. So far as I have seen, only the points of the young shoots are nipped. The older leaves and stems are as bright as before the frost.

Third—On low ground. Trees from three to six years old.

Fourth—The frosts of previous winters have not been so severe as they have this winter. The trees need no protection here.

*El Dorado County*—W. C. L. Drew, El Dorado:

First—From ten to twelve degrees below freezing point every night for several weeks.

Second—Very few of the citrus family have, up to this time, been cultivated in this section. After a careful examination, I do not think the trees are materially injured. Young shoots were killed; but wood of one or more seasons' growth was injured very little, if any. Tender leaves were burned on some trees.

Third—Specimens examined were selected on both high and low ground; very slight difference in degree of injury; age, one to five years; oldest least injured.

Fourth—It has generally been conceded that our section was too cold for the citrus family. Experiments have demonstrated, however, that they can be quite successfully grown if slightly protected. A high fence on the north would be quite sufficient protection. A smoke fire might be necessary a few nights in spring. In several instances, when so protected, they have borne fruit. What makes me more certain of this is the result of examinations of eucalyptus trees in the San Joaquin Valley. These trees were greatly injured by frost. They are hardly touched in our section, except that the tips were burned on trees

under one year old. Trees, however, that were bought in Sacramento and brought here, suffered much more than trees grown from seed in our own section.

*San Joaquin County*—W. B. West, Stockton:

First—The lowest was on or about the 2d of January, seventeen degrees above zero. It was often twenty-four, twenty-six and twenty-seven degrees. The chief damage was done by long-continued frosts.

Second—Nursery trees, especially budded ones of one and two years, all killed; both orange and lemon. Older trees killed back only to two-year-old wood. Old seedling trees are not injured, except the leaves. The loss was not so great in town, except on newly-planted trees.

Third—High ground.

Fourth—The orange can be cultivated in sheltered places like towns, or where evergreen shrubbery is planted around them. Lemon trees are much more tender.

Dr. E. S. Holden, Stockton:

First—December 22d, 1879, eighteen degrees above zero; the lowest this season.

Second—Orange trees and their family have not suffered so far by frost or cold, excepting those two years old and under. The leaves look dry and withered, yet may not be injured. Spring will determine the extent of the injury, if any.

Fourth—Very few of the hundreds of orange, lemon and lime trees in this county have been lost by frost or cold. I have Panama orange trees sixteen years old from the seed exposed to the frost without injury. They have borne good crops of fruit for eleven years.

Maj. L. W. Elliott, Stockton:

First—About twenty-six degrees. The thermometer was at or slightly below freezing point nearly every night during the cold spell.

Second—My observation has been limited to the City of Stockton. The trees which were set out last season, being largely from Los Angeles nurseries, have been somewhat injured, the leaves having been curled up and destroyed; but apparently not affecting the limbs and trunk, except in a very few instances.

Third—Trees that have been growing for more than one season have not been injured much, if any, so far as my observation goes. Bearing trees not at all.

Fourth—There is no doubt that oranges can be successfully cultivated here. The trees that bear prolifically are numerous, and, until this season, not much trouble has been experienced on account of frost.

Daniel Winter, Union Island:

First—From the 14th of December to the 26th the thermometer ranged from twenty-four to twenty-eight degrees. On the 26th it reached the lowest temperature, twenty-two degrees; 27th, 28th and 29th thermometer stood at twenty-six degrees at half-past six o'clock A. M.

Second—My orange trees, also my neighbors', have had nearly all of last year's wood killed, but I think that by cutting back they will be as good as though they had not received any injury from frosts.

Third—All the ground about me is only five feet above tide water. Age, two and three years.

Fourth—If all our winters were as severe as this, we could not raise oranges and lemons without protection; but for the last ten years prior to this winter they would have stood the frosts without severe damage.

*Contra Costa County*—Dr. J. Strenzel, Alhambra:

First—My thermometer is always kept on the north side of the house. Its previous lowest reading was twenty-six degrees, some years ago. This winter the lowest was twenty-four, then twenty-six, then twenty-five, then twenty-eight, and recently from twenty-nine to thirty-four degrees, observed at about six o'clock A. M.

Second—My oldest orange and lemon trees have not suffered in the least, though here and there a tender young leaf is shriveled. The fruit looks sound. The old citron tree, which had often been frost-bitten and appeared most tender, stood nearly as well as the oranges this time. A young orange orchard of eight hundred trees, third year since transplanting, was brushed in after the cold began; it is not materially injured. Some rows nearest a eucalyptus wind-break are entirely untouched. Sev-

eral grafted varieties, and especially the Mediterranean Sweet, which were carefully protected, have suffered considerably. Two lime trees were killed to the ground. In the neighborhood Mr. Hoffman has a square of grafted orange and lemon trees, early covered, wholly unharmed. The location is exceptionally good. Another neighbor, who delayed covering his yearling trees, finds them crippled and blighted. Scattering trees on warm sheltered slopes and in town gardens are doing well.

Third—My young orchard is finely situated—rich, mellow soil, on an inclined plane well sheltered, the last place on my grounds where the vine gets frosted.

Fourth—Fifteen years ago ice formed one inch thick; this season one-half of an inch was the most. Many of my nursery trees were frozen to the ground that year, but after the decayed tops were pruned off they again grew up vigorously. Young orange trees require protection here, but not more than in Spain, Italy or Florida. This protection can be extended at a trifling expense for material, therefore my answer to your fourth question will be a truthful *yes* and a consistent *no*.

But *labor omnia vincit*, not by the fiat of a sand-lot orator, but by the plodding and untiring care of the intelligent husbandman. Encumbering the land with hundred-acre orange plantations must inevitably prove a financial failure, in spite of the most flattering mathematical calculations; but groves of a few hundred trees, planted on sites designated by nature and faithfully cared for, will not only add to the means of subsistence and bring much wealth to the toilers, but they will remain with them as blessings in many forms, independent of dimes and dollars. We are within fair reach of the metropolis; the greater resources at our command should make us more indefatigable in enterprise, and, happily, our efforts are well seconded by nature. All things considered, no other county in the State is so favorably located for varied culture as Contra Costa. The floods of Joaquin and Sacramento meet the Pacific's waves at her feet, and their humid tidal breezes bear inland the freshest, richest plant food, which, in the interior counties, is available only from surface irrigation. The hills of the Coast and Diablo ranges ward off from her sunny valleys all destructive storms,

while the great diversity in form, aspect and material of the lower ridges will afford satisfaction of every requirement for warmth and shelter, needful drainage and abounding fertility.

Careful observations at all seasons are necessary, of course, to disclose the many portions wholly exempt from severe frosts and blighting winds; but in a number of localities experience has already demonstrated the beauty and grateful richness of the semi-tropical fruits of Contra Costa.

*Alameda County*—H. P. Livermore, Oakland:

First—At my residence, Rock Ridge, in the foot-hills, three miles north of Oakland, I have about fifty orange, lemon, lime and citron trees. About a dozen are seedling trees five or six years old; the remainder, grafted trees two and three years old. My self-registering thermometer shows the lowest night temperature to have been, January 13th, twenty-eight degrees; 14th, twenty-nine and one-half degrees; 15th, thirty and one-half degrees; 16th, thirty degrees.

Second—No damage whatever was done to my trees by frost, nor were heliotropes and other delicate flowers touched in their immediate vicinity, while on flat lands half a mile away the damage has been heavy.

Third—All of these trees are on a hillside from two hundred and fifty to two hundred and ninety feet above sea level.

Fourth—No previous season, for the seven years of my residence here, has shown anything like such frosts. Even these have shown no effect on trees of the citrus family or on the India rubber tree, which is, perhaps, more tender.

Chas. H. Shinn, Niles:

First—At the railroad station, where observations are taken at seven A. M., at two P. M. and at nine P. M., the lowest readings of the thermometer were twenty-nine, thirty and thirty-one degrees. This place is somewhat elevated, and sheltered on the north by hills. At our nursery, one mile from Niles, the temperature was not lower than twenty-six degrees.

Second—Three-year-old limes and lemons in open rows are killed. The leaves are white, the bark yellowish, and no sap, even in the roots. These trees were not irrigated later than August. Most of them were in dormant bud. Limes under

lath shelter, and four-year-old lemons, near an evergreen hedge, were uninjured. Three-year-old oranges in dormant bud are much injured. Not more than one-third can recover. Four and five-year-old oranges, both budded and seedling, escaped with blight of a few tips. The seedlings show more hardiness than the buds. Oranges of our own budding stand better than those brought from Los Angeles a year ago. The frost was less severe on the higher points of ground. A belt of Monterey cypress is an almost complete protection for more than twice its hight. The older orange trees are not materially affected.

Fourth—No frosts heretofore have injured our young stock of oranges or lemons. Once or twice within the past six years a few branches of the limes have suffered. Orange and lemon trees have never needed any protection in this vicinity. We may feel that large trees will be safe, even through such winters as this.

I. C. Woods, Mission San Jose:

First—The three coldest days, the thermometer at six A. M. marked twenty-six degrees in the orchard.

Second—No damage in our neighborhood to either orange or lemon trees.

Third—All the trees at the Mission San Jose are from two to three hundred feet above the level of the sea.

Fourth—No. They have never been known to be injured. E. L. Beard, of Mission San Jose, has orange and lemon trees about eight years old. J. J. Vallejo has orange trees fifteen years old. Messrs. Beard, McClure and Vallejo now have orange and lemon trees loaded with fruit. J. A. Laumeister has trees from two to eight years old. I have one thousand orange trees two years old from seed. Not a single tree of any referred to above, or any of the fruit, was affected by the late long-continued cold weather.

J. M. Gray, Alameda:

First—The lowest temperature on the two coldest mornings was twenty-six degrees.

Second—The tips of the young growths were frozen on transplanted trees aged from two to five years. Trees grown here from seed were not affected. Affected similarly on high and low ground.

Fourth—I do not think the frosts too severe for the successful cultivation of orange and lemon trees in this vicinity.

Rev. W. W. Brier, Centreville:

First—Two degrees below the freezing point in the shade and in the building.

Second—The orange trees have received very little injury, if any. The leaves and young fruit on the lemon trees have been killed. The tender young shoots are also killed, but the trees will undoubtedly live and recover.

Third—Trees on flat land twenty-seven feet above the level of the sea. Age, from two to ten years.

Fourth—The frosts here are probably no worse on the orange tree than at Los Angeles. At the Mission of San Jose, six miles away and about two hundred feet higher above the level of the sea, the lemons received no injury. This climate is rather cold in summer to produce oranges of fine flavor, except in protected localities on the hillsides.

G. W. Bond, Centreville:

First—I did not note the range of the thermometer outside of my conservatory, nor do I know of any one who did. This cold term has been the longest and most severe of any I have experienced here during a residence of more than twenty-seven years.

Second—The cold has had no damaging effect upon my large orange or lemon trees, and very little upon the smaller ones, having merely cut the small, tender shoots that started late in the fall. I have heard of no damage to trees within a mile of this place.

Third—My trees are standards, from two to sixteen years old, unprotected in any way, and planted on rather high valley land.

Fourth—I believe, from my own experience, they can; but very young trees should be protected from such cold snaps. They will require no protection after a few years.

*San Mateo County*—S. L. Jones, near Redwood City:

Second—Damage slight; shown by slight yellow tinge, and, on orange trees, a tendency to curl. Lime and lemon trees still blooming. High ground, foot of lower coast mountains. Trees two years old.

Fourth—No.

*Santa Clara County*—W. S. Rogers, Los Gatos:

First—One night it reached twenty-six degrees; several nights twenty-seven and twenty-eight degrees, and for several nights thirty to thirty-two degrees.

Second—Our orange and lemon trees have not been damaged beyond the tips of the growing shoots. The fruit is all perfect. Some lemon blossoms have not been killed.

Third—Planted on ground from sixty to one hundred feet above Los Gatos creek. Trees from six to ten years old. I have also young trees one year old not injured in the least.

Fourth—No. I am so well pleased with six years' experience that I am preparing new ground to be planted with trees, both orange and lemon, this coming spring. We had tomato vines live through the season several years. It is about from five to eight degrees colder along the creek than on the bench lands where trees are planted.

Dr. W. S. McMurtry, Los Gatos:

First—Twenty-six degrees in the doorway; probably thirty-two degrees among the trees upon the ground.

Second—No damage except to the growing tips of a few limbs, which occurs every winter. The trees are planted on high ground. Ages, from three to twelve years. They have never had any protection.

Fourth—There is no difficulty in raising oranges and lemons here. I now have ripe lemons, half-grown lemons and blooms on the same tree, and all doing well. My oranges are of Los Angeles, Garey's Seedling, Malta Blood, Mediterranean Sweet and St. Michael varieties.

A. W. Saxe, M. D., Santa Clara:

First—I have kept no record of readings for temperature or atmosphere, though I have thermometers and a barometer. Lowest reading, observed at six A. M, twenty-four degrees; reported by neighbors as low as twenty-two degrees Fahrenheit.

Second—I have orange and lemon trees from three to eight years old. The older trees have suffered very little, losing a few leaves. The younger lose most of their foliage. Those shaded a little from the morning sun are uninjured. My own have suffered very little. The damage consists of the killing of

the margins of the leaves, and, of some young plants, from two to four inches of the extremities of the twigs, but this does not seriously injure the plants. My trees are growing on loam, with gravel subsoil. My neighbors, whose soil is black adobe, with clay subsoil, have suffered more than I. I notice on low black land some young trees that have lost all their foliage; probably they will die. Mature trees, from five to ten years old, that is, trees with wood well ripened, not irrigated late in the season, suffer least of all; and none at all on loamy soil with gravel subsoil. It is my opinion that seedlings—Garey's seedlings and other good domestic seedlings, for example—resist frost better than St. Michael, Mediterranean Sweet, Malta Blood and other imported sorts.

Fourth—I have grown oranges of fine size and flavor on my grounds; but it is my opinion, after careful observation, that oranges will not be a sure crop in the valleys of this county; but that they may be grown to perfection on the foot-hills on either side of the valley. Trees bearing full crops may be seen at Los Gatos and elsewhere near the foot-hills. Messrs. Rogers and McMurtry, of Los Gatos, have a fine exhibit near the present terminus of the South Pacific Coast Railroad.

*Stanislaus County*—Thomas Roberts, Knight's Ferry:

First—The lowest reading of the thermometer, from what I can learn, was twenty-eight degrees. Some nights ice formed from one-quarter to one-half inch in thickness.

Second—The young trees were shriveled a good deal during the freezing weather, but when the weather moderated they returned to their usual freshness, with the exception that a few leaves are a little yellowish and that some of the tips of the tenderest shoots are nipped a little. I think they have received no permanent injury worth mentioning. The trees are from two to eighteen years old, planted on rather low ground from three to six feet above the river bank, with a northern aspect, and sheltered considerably from all winds.

Fourth—During a residence of eighteen years in this place I do not remember having previously seen so much frosty weather, and for so long a time, but I may have seen as thick ice, if not a little thicker. I have noticed that lemons, in years past, have

been affected by frost, where they have been exposed; but scarcely any this season, and the oranges none at all. Neither bearing orange trees nor the fruit has ever been damaged by cold weather in this place that I am aware of.

*Tuolumne County*—John Taylor, Chinese Camp:

First—Lowest, twenty-six degrees in the shade. I do not know what it was among the trees. Solid ice formed from one-fourth to three-fourths of an inch thick. The salvation of the trees seemed to depend on protection by shade and the absence of wind.

Second—It is with pleasure that I answer number two, having orange trees in my own garden, and having noticed those of my neighbors. Only a few leaves, and those most exposed, show a blight. My few trees are from two to six years old. They are all green and apparently uninjured. A few days ago I saw trees with golden yellow fruit, with only a few leaves injured.

Third—The trees I speak of are planted in small valleys, sheltered in a measure by surrounding hills. Some trees must be from twelve to sixteen years old.

Fourth—Some trees have been protected by a thin cloth, others received no protection. The past frost has been the severest in thirty years, the extent of my observations—but I do say I have great faith in these foot-hills for the future of oranges, lemons and limes. A range of twenty-five miles from the plains toward the Sierra, and commonly known as the "Foot-hills," will, owing to the natural protection and facilities for irrigation, ultimately be more successful than the plains, over which the wind has a strong, cutting sweep that will destroy young and tender trees. Our not being subject to such winds makes the frosts almost harmless. I have on the south side of the house a small seedling, about a foot high, that was exposed, unhurt. I am fully satisfied that the foot-hills will give the best showing for orange culture. Capital and capability have hitherto sought the sunny south; but we have advantages not possessed by very high or very low latitudes. The quality of all fruit raised in the foot-hills is superior to all other fruit in California—a fact which will in time commend itself to horticulturists.

J. W. Keith, Chinese Camp:

First—Twenty-eight degrees above zero. Our place is from two to three weeks earlier than other parts of Tuolumne county. Our fruit ripens at about the same time as at French Bar, on the Tuolumne, and at Knight's Ferry, on the Stanislaus.

Second—New growth on young trees has frozen back from six to eighteen inches, according to its maturity. Last year's growth does not appear to be affected. We have a few trees with oranges on them at present which have borne for nine years. Trees and fruit appear to be uninjured.

Third—Near the river, but well drained. Age, three years from the bud; not bearing.

Fourth—My trees have had no protection. I think they are not seriously injured. Judging from our old trees, I think they can be successfully cultivated in our vicinity.

Jules Reynaud, Green Springs:

First—Lowest point, under a shed, twenty-eight degrees.

Second—My orange suffered none from the frost. My lemon trees, planted about sixty feet west of them, were frozen, the leaves turning from green to yellow. The fruit became soft, but is yet excellent.

Third—I am in the hills. My trees are planted on a little flat sheltered by a large hill. Orange trees with fruit, nine years old; lemon, two years old.

Fourth—The frost had no effect on my tropical trees before this year, and it has affected only my lemon trees this year. My bearing orange tree was raised from seed. It bore three oranges the first year, three hundred the second, and this year fifty dozen as large as Tahiti oranges.

*Merced County*—M. D. Atwater, Merced:

First—The thermometer was as low as eighteen degrees one or two mornings, but it was not generally lower than from twenty-seven to thirty degrees. This was at Merced. My place is five miles above Merced, on a slight elevation. We have in our front yard a lemon tree four years old, not injured at all by the frost. About all the damage that was done by frost in this vicinity was done to young trees that have been set only a year or two. The extent of damage to them cannot be ascer-

tained at present, but all with whom I have talked about them seem to think they will come out all right in the spring.

Fourth—On the contrary, I believe the severe test the older trees have stood during this unprecedentedly long spell of frosty weather will encourage more persons to cultivate the orange and lemon than have cultivated them heretofore.

*Fresno County*—Prof. W. A. Saunders, Kingsburg:

First—From twelve to sixteen degrees Fahrenheit below freezing point. There has been *no* frost in some places in the foot-hills. The above is for the region of the "colonies" in the great valley.

Second—Young trees and those trained low are killed in some few cases. Tall trees six years old and upwards, especially seedlings, have usually lost only their late succulent fall growth. The vitality of trees is not otherwise affected.

Third—Our country is a vast plain, estimated to be from two hundred and fifty to three hundred feet above the sea level.

Fourth—No. There are in this county many bearing orange trees which produce superior fruit, and very bountifully for trees of their ages. Eight-year-old seedling trees are proof against any frost we have yet had. Garey's sweet rind lemon stands cold perfectly. Lime and citron trees are easily killed. Pumalos are but little more hardy. I cannot give specific accounts of what the cold has really done.

A. L. Bartlett, Kingsburg:

First—Lowest, eleven, thirteen, fifteen and seventeen degrees.

Second—Most of the yearling trees (budded) killed; older ones lost part of the latest growth, and all of it in a majority of cases. Low ground. Age, from one to five years. Seedlings stood the cold weather much better than budded varieties. Hardy varieties of the orange seem to have stood the frost better than lemon trees of the same age.

Fourth—Not necessarily; it depends largely on the condition of the soil and the manner of cultivation. Too much irrigation this season proved disastrous in many cases.

*Tulare County*—Mr. Bahwell, Visalia:

First—Lowest in December, twenty-one and one-half degrees; in January ditto.

Second—Six-year-old trees on high lands are slightly hurt; they will shed their leaves. Trees ten and twelve years old, on the same ground, are not injured in any respect. Trees are a failure on low lands.

Fourth—On high lands with water their cultivation is a success.

*San Luis Obispo County*—B. R. Harris, San Luis Obispo:

First—The mean readings of the thermometer at the County Hospital, situated on an elevated plateau perhaps eighty feet above the surrounding plain, for two months ending January 20th were: at eight A. M., forty-seven degrees; at M., fifty-seven degrees; and at eight P. M., fifty degrees; highest, sixty-nine degrees; lowest, forty degrees; lowest in the valley, thirty-six degrees.

Second—No damage to speak of has been sustained, except in rare cases, and then it was confined to seedlings one year old, planted on low, moist ground, and in cases in which the young plants had attained an exceptionally rank and tender growth. Those planted on elevated dry land have entirely escaped. Orange trees have in the latter case been blooming and bearing fruit all winter.

Fourth—A strip of country lying along the western base of Santa Lucia or Coast Range, bordering on the open coast lands, and averaging three miles in width, and extending from Cambria on the northwest to the Santa Maria river on the southeast, is almost entirely free from frost. Oranges and lemons can be successfully cultivated within said described limits.

*Santa Barbara County*—Ellwood Cooper, Santa Barbara county:

First—Lowest point indicated by thermometer on my ranch, thirty-four degrees. I have only a few orange and lemon trees; no apparent injury was done to any of them. All are protected, however, by forest trees.

Second—I have not examined any trees of either of the above varieties, except the orchards of Col. W. W. Hollister, in which there was no apparent injury. I have understood that in Santa Barbara nearly all the young growth on young trees was killed.

Third—Trees planted on low land. I think there could not possibly have been any injury done by frost on the table lands.

Fourth—There has not been cold enough during my eight years' experience here to injure either orange or lemon trees planted on table lands, or on the slopes of the foot-hills. It is my firm belief, however, that all fruit culture, to be successful, requires protection from frost.

Col. Hollister, Santa Barbara:

First—Thirty-one degrees above zero, thermometer hanging on a tree, four feet from the ground, by the side of the orchard.

Second—No effect, except a little paler color in the leaves of the latest growth. I do not regard it as particularly damaging. I have heard of no damage to trees in the neighborhood.

Third—Planted in a valley among foot-hills, two hundred and eighty-five feet above the sea. Trees seven years from seed.

Fourth—No. This has been the coldest winter in ten years. The climate and soil seem admirably adapted to their growth. My orange trees are fruiting for the first time. Lemons fruited at five years.

*Ventura County*—Robert Lyon, Cliff Glen, San Buenaventura:

I shall answer your inquiries as fully as they may be answered at this date, in regard to the recent doings of Jack Frost among the orange groves of Ventura county. In some localities only the outer leaves and late, tender growth of wood are killed; some of the center branches, which had the protection of the top of the tree, are still alive and green. This is the case with Mr. Sparks' lime orchard, containing three hundred four-year-old trees, all in full bearing. Mr. Sparks has furnished the local market of Ventura with limes since last November, and although some of the fruit on the outer side of the trees was frozen solid, those protected by the heavy foliage were uninjured. Some orchardists are of the opinion that those trees will all die to the ground and sprout again from the root. Others believe that by removing all the dead branches, by pruning, only one year's growth of the tree and one crop of limes will be lost. My own opinion is that it will require two years for the trees to recover; that they will remain dormant for nearly a year before they will put forth a shoot, and that it will require another year for them

to grow before fruit buds will start. This orchard is situated on the bank of the San Buenaventura river, two miles north of San Buenaventura. The soil is clay, sandy loam, without gravel; elevation about eighty feet above the ocean's level. The lowest record of the thermometer in this vicinity is twenty-nine degrees above zero. The orange and lemon trees from five to seven years old, at the rancho Jose Arnez, and at the Stevenson place, six miles farther up the river, have the appearance of being dead, while Henry Shaw's nursery, containing twelve thousand orange trees from three to five years old, and several lemon and lime trees from two to five years old, is uninjured. This nursery is situated in Ventura avenue, a half a mile north of San Buenaventura, at an altitude of about sixty feet, on the same stream that Sparks' lime orchard is on, and in the same valley, but it is better protected from the cold north wind. In this orchard only an occasional tender shoot is nipped. There is no thermometer record of the degree of cold. S. Bristol informed me that the frost did not injure his trees. His place is in Santa Clara Valley, about four miles from the coast. The orange and lemon trees of Messrs. Canon, Finney and Day are in this vicinity. I have not visited their places, but I hear that their trees have sustained no injury from frost.

The most extensive orange orchard in Ventura county is that of Messrs. Blanchard and Branley, situated at the mouth of San Pablo cañon, on the west side of Santa Clara Valley, seventeen miles from San Buenaventura. Mr. Blanchard informed me yesterday that his trees had not been injured. They have only occasionally been nipped, and some of them are now growing. This orchard contains one hundred acres set to orange trees that will be seven years old this coming spring. The soil is a gravelly loam. The altitude is about two hundred and fifty feet. The degree of temperature is unknown. All the orange and lemon trees in the vicinity of Nordhoff are killed. The lowest degree of temperature there is reported to be twenty-six degrees. The soil is clay and gravel—oak timber where not cleared. Altitude, about eight hundred feet. My Cliff Glen orchard is situated about seven miles from Nordhoff, in the Metalaja cañon. The soil is a sandy, gravelly loam. Altitude,

twelve hundred and sixty feet above the ocean level. San Buenaventura river runs near the orchard. My trees were all irrigated in November. The frost has left its mark on some of my orange and lemon trees at Cliff Glen, by nipping some of the tender growing shoots, but that will not injure the trees or check their growth. Some of my trees are now growing and putting forth new shoots from the tips of the branches. I have five hundred orange and lemon trees from five to seven years old. My three-year-old orange trees in nursery are not injured; my yearling lime trees are killed to the ground. No thermometer record was kept at Cliff Glen during the past winter, but for the three previous winters the lowest temperature at any time was thirty-one degrees above zero. Tomato and melon vines have all been killed this winter at Cliff Glen, for the first time in six years. It is not usual to shelter any kind of trees in Ventura county. Some places in this county are too cold for orange trees; but they are perfectly safe in favored localities.

D. S. McLean, San Buenaventura:

First—Thirty degrees, three nights.

Second—Not even a bud killed, much to the astonishment of owners of orchards.

Third—The orchards are in valleys open to the sea; elevation, perhaps eight hundred feet; age of trees, about six years.

Fourth—This has been the coldest season for certainly seven years, but no harm whatever has been done, either this season or previously. A draft of warm air from the ocean, often moist, drifts up the valley every night.

S. Bristol, San Buenaventura:

First—Lowest I have heard reported, forty to forty-five degrees.

Second—No damage to the oranges and lemons, and none to the trees, except, possibly, some very small ones. We consider that the cold snap did us no harm, so far as semi-tropical fruits are concerned.

Third—The trees in our county are planted along the shore and back thirty miles in the mountains. Some orchards are twelve hundred feet above the sea level.

Fourth—An experience of eleven years in Ventura county

affords me the fullest assurances that oranges and lemons will prove to be a complete success. Our thermometer never shows so low a temperature as at Los Angeles. We do not regard a wind-break essential to success.

*Los Angeles County*—Ex-Gov. John G. Downey, Los Angeles:

I visited the counties of San Diego, San Bernardino and Los Angeles during the cold weather, and had a fair opportunity to observe the effect of the frost upon all classes of unprotected trees of the citrus family. The lowest reading of Fahrenheit's thermometer (the only one in common use) was twenty-eight degrees. Bearing trees of the orange and lemon family were not affected, save in a few instances, in which the young and tender shoots were nipped; but this, you might say, is a yearly occurrence. Trees of this class, from three to seven years old, were equally uninjured. Young trees one and two years old, in nursery, were badly bitten, yet but few were killed. These suffered most in low, damp situations. Those that were not killed were set back nearly a year's growth. The lime trees seemed most sensitive to the cold, and, in many instances, they were badly bitten. They will have to be pruned back extensively. The very young ones in the nursery are seriously injured. It seems unaccountable how the frost acted, running in streaks in the same orchard. High table land with good drainage seemed to defy the cold. The nearer the Sierra the better, although the snow was close by. High fences and good hedges seemed to have a happy effect to prevent damage.

Judging from close observation and more than ordinary attention to the subject for twenty-eight years, there is nothing to indicate any apprehension touching the successful cultivation of the orange, lemon and lime in the counties above mentioned, and without protection.

Gen. Stoneman, San Gabriel Valley:

First—The thermometer at my place, Los Robles, on the rim of the San Gabriel Valley, went one night to twenty-nine degrees, and ice formed one-eighth of an inch thick. Nothing was injured on my place, except some young bananas in an exposed situation.

Second—My orange, lemon and lime, also citron and pome-

granate trees, were not affected by the cold this winter, and never have been. Some of my neighbors, living lower down, had some of their young trees cut back—a few to the ground.

Third—Neither young nor old trees, on *high ground*, have been injured; nor have trees upwards of eight years old been injured much on low ground, only the tender growth of this year having been affected.

Fourth—By no manner of means. After the frost-bitten leaves on the young trees shall have dropped, one will not realize that there has been such a thing as a frost in these parts this winter. By "these parts" I mean the sunny, tropical "fruit belt" of Los Angeles county, or the northern part of San Gabriel Valley.

G. A. Morenheaut, Los Angeles:

Large orange trees, even when exposed in open spaces, have hardly suffered any, a few new, tender shoots at the tops of the trees being all that were scorched, and those but little in certain localities. This will do no harm to the trees themselves.

The full-grown lemon trees have suffered a little in some localities, but hardly anything with the exception of very young trees imperfectly sheltered by their leaves.

The little lime trees, whose growth never exceeds that of a bush, and which are more sensitive to frosts, have suffered severely everywhere; many are completely destroyed.

Young orange trees from three to four years old have been unable to withstand the frost in many localities in this county. They are only from three to four feet high, an inch or an inch and a half in diameter, with only a small tuft of leaves at the top. [The method of pruning an orange tree so it will be such a tree as is herein described, with only a small tuft of leaves at the top, is pernicious in the extreme, as stated in the chapter on pruning. But no kind of treatment can make them as hardy as old trees.—AUTHOR.] They have been so severely treated that the growth of those not killed will be retarded by one or two years, and if we do not have a warm rain soon, many more will not recover from their injuries.

Of all the citrus trees the limes seem to have suffered most, being, as I said before, much more sensitive to cold. Wherev r

they were not protected from the northeast winds they have been destroyed by frost.

The nurseries of both orange and lemon trees have been severely treated in many places, most of the young shoots having been completely killed, excepting, however, such as were protected by close line fences. The loss occasioned to nurseries and young plants will probably amount to many thousands of dollars; but I would repeat that the bearing orange trees have not been injured by the frost.

The temperature during the frosty weather did not fall below twenty-nine degrees Fahrenheit in this city, although on the plain out of town it was probably a little lower. Most of the citrus family are planted on high ground, and are all in localities where there is water with which to irrigate at any time of the year, if necessary.

The oldest orange trees in this county average from twenty to twenty-five years of age, except those of the Mission San Gabriel, which are supposed to be fifty years old. Few trees bear before the age of ten.

L. J. Rose, Sunny Slope, San Gabriel Valley:

First—I paid no attention to the thermometer. We have had more continued cold weather than I have known before for twenty years, though we have had a few days as cold at two different times. Ice formed here several nights from one-sixteenth to one-eighth of an inch thick.

Second—There has been no apparent injury to either orange, lemon or lime, as a general thing, in San Gabriel Valley. Young limes and lemons had the ends of last year's growth frozen back and killed at some few places, but no tree was injured more than temporarily. All the citrus family have been much injured in some portions of the county and killed in some cases.

Third—Orchards are generally planted on high ground; those on low lands have suffered severely.

Fourth—The trees have been planted, generally, without any protection, but there has never been any serious injury from cold. A plantation protected by others, or even by large orange trees, is less liable to frost than one open and exposed. The orange can and does stand much cold—more than the lemon or lime.

Thomas A. Garey, Los Angeles:

First—I kept no record of readings of thermometer.

Second—My orange trees in orchard form are not injured in the least. Our standard trees in the Coöperative Nursery and Fruit Company's grounds are uninjured. Nursery trees (principally Garey's Mediterranean Sweet) from two to three years old from the bud, nine-tenths are uninjured. Three-fourths of one-year-old buds are killed to the original stock; the other fourth are badly damaged.

Third—The trees mentioned above are located within and adjoining the city limits of Los Angeles. Distance to surface water from about forty to sixty feet.

Fourth—This is the severest freeze known since I engaged in the nursery business, in 1865. In some localities, where the land is low and surface water is within say from ten to twenty feet, trees will need protection until they attain an age of three or four years from the bud.

O. W. Childs, Los Angeles:

First—The lowest reading of the thermometer at the United States Signal Service was on December 14th, 1878, thirty degrees. I do not think it read any lower than this in any of the orange orchards.

Second—No damage whatever to bearing trees, and none to nursery trees, except in cases in which too much irrigation late in the season caused small trees to continue growing till checked by cold weather; this new growth has been killed on low lands.

Third—Age, from one to two years, and some newly-budded trees, buds just starting, on three and four-year-old stock; only the starting buds injured.

Fourth—No.

Dr. Pigne Dupuytren, Los Angeles:

First—I did not notice the readings of the thermometer.

Second—Trees under four years of age have generally suffered, and will be retarded one or two years. Some think the growth will be increased, rather than retarded, but this is hardly probable. The very young trees—under two years—can be considered as lost. Large trees more than seven years old have not suffered. It can generally be said that lemon and citron have suffered more than orange trees.

Third—The orchards are on level or low land, there being no hill in the vicinity of Los Angeles. [There are some low hills in the northern part of the city and more to the north and east, yet but very few trees are planted on them, some of them having no water.—AUTHOR.]

Fourth—Many farmers have planted Mexican limes for fences. It can be said that all or nearly all are lost. Some have been preserved without injury, but they were protected by other trees, as willows, etc.

W. R. Olden, Anaheim:

First—December 18th, thirty-three degrees; 19th, thirty-three degrees; 25th, thirty-two degrees; 1879, January 9th, thirty-four degrees; 10th, thirty-two degrees; 11th, thirty-four degrees; 15th, thirty-one degrees; taken from a self-registering thermometer in an orange grove in the open country outside of Anaheim. (No cold weather since January 15th.)

Second—No orange or lemon tree within a circle with a radius of five miles from Anaheim has been frosted in the slightest degree. Even lime trees, bananas, tomato and potato vines are untouched. Oranges and lemons have never been injured in Anaheim. It is protected by a range of hills north of town, and which keep off the mountain wind.

Third—All ages, from small seedlings to old bearing trees. From eighty to two hundred and fifty feet above the sea level. The hills protect all alike.

Fourth—Neither orange nor lemon trees have ever been injured in Anaheim or vicinity by a winter frost. A few trees on the outside were injured by an April frost in 1875, but they were not materially damaged. That is the only instance of damage in this city in twenty-nine years.

*San Bernardino County*—Dr. Barton, San Bernardino:

First—In the lower lands in this county, as low as twenty-five degrees in this neighborhood. At Old San Bernardino, that being bench land, it did not go lower than thirty degrees.

Second—No damage was done to orange and lemon on high lands, except to the leaves and tender young shoots on trees under three years old. Older trees, and even young ones with wood well matured, have not suffered. Trees under four years

old, on low damp ground, are killed. Many of the older trees in the low lands have the leaves all killed, but they will put forth new leaves.

Fourth—This is the first year in which trees have suffered to any extent in this county. The damage has not been sufficient, even this season, to discourage the cultivation of oranges and lemons on the higher ground.

P. S. Russell, Riverside:

First—On one or two mornings, twenty-seven degrees; generally, twenty-eight to thirty degrees. About twenty mornings the thermometer fell below freezing; very unusual for this place.

Second—No material damage except on very low lands. Age of trees, from three to ten years. Generally speaking, no damage at all to orchard trees. Budded trees in nursery are hurt in some places; in others, not.

Fourth—No; in proof of which see the thousands of orange and lemon trees on every hand, as green and fresh as ever, many of them loaded with golden fruit of the finest of any in the State.

*San Diego County*—Thomas L. Nesmith, San Diego:

First—In San Diego the lowest thermometer was between midnight and sunrise; from forty-six down to thirty-six degrees. It was from five to ten degrees lower in the neighboring valleys, being lowest at one or two points in the Cajon Valley, sixteen miles distant. There are in nursery in this valley many young lemon and orange trees which suffered from the frost.

Second—The principal damage, if not the only damage, was done to young trees in nursery in Cajon Valley. Five thousand dollars is certainly the extreme limit of the damage done. Bearing trees were not perceptibly affected anywhere. The trees in town and on National ranch received no damage worth mentioning. All trees on high or mesa land, even the youngest in nursery, escaped uninjured.

Fourth—They have not. No remembrance of any such weather in any previous winter. Frost is a very remarkable phenomenon here.

The conclusion to be drawn from this mass of testimony is, that orange growing is no longer an experiment in the north,

and that notwithstanding the severe frosts of such winters as this, orange and lemon trees can be profitably cultivated in nearly every county in the State. By selecting favorable locations, no district, from San Diego to Siskiyou, except it be situated in the high Sierra, need be without these most beautiful and useful fruits. One point is brought out by these reports, namely: the very little difference in the severity of the frosts and in the injury to young trees in the northern as compared with the southern parts of the State.

The orange is the hardiest member of the citrus family, and will endure a much lower temperature without serious injury than is generally supposed. It will be noticed that not one of these statements mentions any material damage to bearing trees, and very little to trees more than four or five years old. It is evident that none but very young trees require any protection at all, and then only in unusually severe seasons, and when growing on low ground. The general verdict is in favor of the idea that seedling trees are the most vigorous and hardy, while many cultivators believe that such trees, though longer in coming into bearing, are, in the end, more reliable and productive. The temperature has not been sufficiently low at any point from which we have heard to determine exactly how many degrees below freezing an orange tree will survive. During the great freeze in Florida, in February, 1835, the mercury fell several degrees below zero at St. Augustine, killing to the ground nearly all the trees in the State, some of which were a hundred years old. The roots of most of these trees sent up sprouts, which were in full bearing in 1842. Orange trees in that State have been known to shed their entire foliage from the effects of frost, and still produce a crop of fruit the ensuing summer. It is therefore quite evident that the cultivator of the orange in this State has little to fear from the frosts of ordinary winters.

The lemon is much more sensitive to cold than the orange, probably from its tendency to continue growing late in the season. It generally throws out new wood and blossoms throughout the winter months. It will require protection when young in many localities where the orange passed the season unscathed. Sufficient evidence has been brought out, however, to

show that this fruit can, with a little trouble, be grown over a large area in the central and northern parts of the State. The citron and the lime are still more tender than the lemon, and their culture will be attended with difficulties in most situations north of Point Conception.

A very large space is given up to this report, but we believe the importance of the subject to the State at large is sufficient justification. Many of the contributors are among the most experienced orange and lemon growers in the State, and several of them are owners of some of the largest orchards. The scraps of information interspersed here and there will therefore be of great value to novices in the business, who will find it worth preserving for future reference. It will give our Eastern readers an exact idea of what an unusually cold winter in California really is; and to the intending immigrant what an extensive area is spread out before him from which to select the site for his future orange grove.—*Bulletin.*

The following is additional evidence of the extent of cold that bearing orange trees will endure without injury:

"The question seems to be an open one whether or not oranges can be raised in California elsewhere than in the semi-tropical south. When in Europe, in 1866, we spent a winter in Naples. This is an orange country. Sorento orchards, some twenty miles away, are famous. Sicily is not so far from Naples as Los Angeles is from San Francisco. During this winter, and for weeks at a time, we saw the fountains frozen up, icicles formed into great blocks of ice, the ground congealed, and vehicles rattled over frozen pavements that did not for days yield to the melting influence of the sun. The wind came howling down from the snow-clad summits of the Apennines, yet no orange trees were injured, nor did the inhabitants seem to regard this cold spell as exceptional. Young orange trees must be nursed through the tenderness of their infantile days. They are hardy trees when grown."—*Argonaut.*

The following, from the pen of Prof. W. A. Sanders, of Fresno, I consider of sufficient importance to merit a place here:

"The thermometer has twice been sixteen degrees below the freezing point during the past thirty days. Unprotected orange

trees have been much injured. It is impossible to tell at the present time how much injury has been done. Certainly all the soft wood of the late autumn growth has been killed. Many low, budded trees have doubtless been killed down to the stock on which they were budded. Low trees are usually worse injured than tall trees, and budded trees worse than seedlings, which possess more hardiness on account of greater uniformity in growth of roots, trunks and branches. Our severe injurious frosts here in the great valley occur only after dry autumns, and then only in the latter part of a dry December and the earlier part of a rainless January. In our usually rainy autumn weather we have fogs or clouds at night, that dispel frosts and injurious cold. But when the weather is cloudless during December and the early part of January, the cold becomes more and more intense, night after night, until finally ice will form on still water an inch thick in a single night. Though this is an obstacle, it is not a barrier to successful orange culture in our valley, as is clearly demonstrated by a little careful observation among the oldest bearing orange trees in almost all parts of the great valley. But it makes the question of protection from frost one of great importance. I trust that I have above pointed out with sufficient clearness the indications showing the approach of weather that will necessitate some form of protection to young trees or those not thoroughly acclimated.

### MANNER OF PROTECTING TREES.

"After many years of experience, I have repudiated the idea of *covering* the trees, as I have discovered a better, cheaper and more expeditious way of accomplishing the desired result. Save the manure from the stable during the entire year. Then, say some time in November, if the weather be cold and dry, haul your pile of stable manure into your orchard and pile it in piles two or three feet in hight, like small hay-cocks. Make a pile *near* each tree, but *don't* let the manure *touch* the bodies of the trees. Make the piles compact and a foot away from the trees. When frost begins, pour a bucket of water on the top of each pile; this will set the manure to heating, and cause it quickly to throw out an amount of heat and steam that will be a better

protection than anything else I have ever tried. I have protected tomato vines in this way and kept them bearing during a month of freezing nights. The manure should be watched, and more water be added, and possibly more manure, if the freezing weather be very severe or of very long duration.

"One man with a two-horse team will haul manure forty rods and pile it so as to protect four or five acres of trees in a single day; then, if he have a water cask with hose, to put on his wagon, the wetting of the piles will be but the work of an hour or two."

# CHAPTER XXIII.

## Varieties.

The varieties of oranges are very numerous, the oranges differing more or less in form, size and color. There is also more or less difference in the blossoms.

I have raised the following varieties, some of which I have fruited. The greater part of them are comparatively worthless, but I give their names that seekers after information on the subject of orange culture in California may know what varieties have been cultivated here, which knowledge may possibly save the expense to some of importing some of the varieties. All of them that are worthy of cultivation, and many that are not, can still be found in Los Angeles county: Konah, Acapulco, Large St. Michael, Small St. Michael, Small Thin-skinned or Paper-rind St. Michael, Malta Blood, Maltese Oval, Garey's Mediterranean Sweet, Pumalo, Los Angeles, Chuchupilas, Bitter, Myrtle Leaf, Pernambuco, White Orange, Du Roi, Variegated Orange, Small Tangerine, Large Tangerine, Exquisite, Bergamot, Small Sour Sandwich Island, Large Chinese, Prolific, Forbidden Fruit, Emperor Mandarin, Coolie Mandarin, Dwarf Mandarin, Canton Mandarin, Thorny Mandarin, Emperor of China, St. Jago, Egg Nutmeg, Egg, Seville, Rio, Teneriffe, Paramatta, Heong Leong, Sabina, Cumquat, Queen, Poor Man's Orange, Seletto, Bouquet, Tahiti, Loretto, Excelsior, Florida Seedling, Navel or Bahia, Washington or Riverside Navel, Portugal.

# CHAPTER XXIV.

## Best Varieties to Plant.

From the large list of varieties named in the preceding chapter I would select but three or four to plant in orchard. The principal object should be to select varieties that will produce a first-class fruit.

These are the most essential points in an orange: Medium size, or above medium; symmetrical and regular shape; deep and golden color; fine flavor; fine grained and juicy; few seeds, the fewer the better; and good keeping and shipping qualities. It should also be of a variety that commences to bear early, that will produce large crops regularly, and that covers the greatest length of time possible in ripening. The habit of growth of the tree must not be overlooked. The tree should be a vigorous grower, and, if possible, it should combine with the above requirements an absence of thorns. An orchard of trees possessing all of the above qualities will be almost *perfection*, so far as regards variety. The selection from the list named will be on a basis for an orchard of eleven hundred trees—a little more than ten acres, at twenty feet apart. There are many varieties that have not yet fruited here; of these I would plant only single specimens, or, perhaps, let the nurserymen develop this branch of the business.

I would plant four hundred Mediterranean Sweet, four hundred Washington or Riverside Navel, one hundred and fifty Malta Blood, and one hundred and fifty Thin-skinned or Paper-rind St. Michael.

It is possible that the Small Tangerine should have a place in the above list; but its size is objectionable, and as its keeping and shipping qualities are yet unknown, I cannot recommend it to growers.

Brief description of the above-selected varieties, including the peculiarities of the different trees:

Garey's Mediterranean Sweet I introduced to the public myself. Considering all things, I think it is the best variety to plant. The history of this orange here, so far as I know, is as follows: About the year 1870 I imported several varieties of orange trees from Messrs. Ellwanger and Barry's nursery, at Rochester, New York. I think the importation included all the varieties offered for sale by this firm. One of the trees was labeled *Shaddock*. When this *Shaddock* fruited, the fruit proved to be a first-class orange, instead of the coarse, worthless fruit its name led me to expect. I called it "Garey's Favorite," but subsequently christened it "Garey's Mediterranean Sweet." Wishing to obtain the correct name of the fruit, I forwarded to Messrs. Ellwanger and Barry, in July, 1877, a specimen which elicited the following response:

"Your favor of 27th ult. came duly to hand. The orange sent by express also received. It was quite sound. It is a large, handsome fruit, skin very thick, flesh sweet. It is singular that you should have received it as a Shaddock, which is a very acid fruit."

The rind is about the same thickness as that of Los Angeles seedlings; it is pronounced "very thick." It is not characteristic of the orange, however, to have a rind more than about one-fourth of an inch thick; it is rarely, if ever, found thicker.

Still desiring to learn the true name of this orange, and being willing it should, if ascertained, take the place of the name under which I had disseminated it, I called upon the Directors of the Southern California Horticultural Society and requested them to take steps to ascertain the real name of the fruit. It is now about a year since the subject was first brought to the notice of the Society. The Committee on Nomenclature have neglected or refused to do their duty fully in this matter.

The following is extracted from an article in the *Horticulturist* in reference to this orange:

"The Committee on Nomenclature desired to get at 'bottom facts,' and sent some of the fruit and foliage of both the Exquisite and Mediterranean Sweet to Messrs. Ellwanger and

Barry, from whom they were imported into this country, though it is claimed that the latter arrived labeled *Shaddock*. They were requested to compare the samples with trees and fruit in their possession, and, if possible, give their true name. They replied substantially as follows, May 8th, 1879:

"'The oranges arrived safe, but the foliage was so blackened and broken they could not make the necessary comparison. They thought the large orange (Mediterranean Sweet) was the finest they ever cut. The small one (Exquisite) was evidently imperfect. They received those varieties from Rivers, of England, but had not fruited them. It did not pay there to give them the care and place they need to yield fruit in perfection. They could not give the desired information.'"

They sent twigs and leaves of the Exquisite which compared favorably with those of the Exquisite here, but they were very different from those of the Mediterranean Sweet.

A branch and sample of leaves were sent to A. I. Bidwell, the leading nurseryman of Florida, who replied that he recognized the branch as the so-called Mediterranean Sweet, and that he had several trees of this variety in his nursery. He sent by mail a small budded tree of the Exquisite, which he said would be found to be entirely distinct from the branch sent him.

The tree sent by Mr. Bidwell came through in good order, without a wilted leaf. The foliage was like that of the Exquisite sent us by Messrs. Ellwanger and Barry, and fully establishes the character of this variety, which is a dwarf, of light growth, small leaves, short, slender thorns, being unlike the Mediterranean Sweet in every respect.

The Mediterranean Sweet is unlike any other orange known to the fruit-growers of Southern California. It was sent from this State to Florida under the name by which it is now known.

The firm of Ellwanger and Barry stands at the head of nurserymen in the United States, and Mr. Barry is Chairman of the General Fruit Committee of the American Pomological Society. This renders of great value their testimony that the Mediterranean Sweet was the finest orange they had ever cut.

The Navel is a native of Bahia, Brazil. It is a good orange the most prominent distinguishing feature being a protuberance

more or less developed in all specimens, at the blossom end of the fruit, from which peculiarity it derives its name. It has been thought to be a shy bearer, but has recently been proven to bear well in this climate, and, for aught I know, to bear heavily. It is a fine large orange, extraordinarily handsome in appearance, and seedless. The tree is a great grower and almost thornless. Its keeping and shipping qualities have not yet been fully tested, but they are considered to be good.

The Washington or Riverside Navel is a superb orange, and will now divide the honors with my Mediterranean Sweet. Its introduction into this country is as follows, according to the Riverside *Press:* The Riverside Navel is a direct importation from Bahia, Brazil, through the Agricultural Department at Washington. Until the trees fruited it was supposed to be the same as the Navel previously imported to this State from Florida and Australia. As soon as the Bahia trees fruited it was seen at a glance that the fruit was superior to the Navel imported from other places, and the superiority of the fruit was so marked that it was at once named the Riverside Navel to distinguish it from the other Navel, which was then called the Australian Navel, to distinguish the two. The cause of difference in the two Navels is not so easy of explanation, but it is generally thought that the Riverside Navel, being a direct importation, is pure, while those trees brought from Australia, more particularly, might have been propagated on inferior stocks for a number of years, until the fruit had deteriorated in quality.

The Malta Blood is my third choice. As its name implies, the flesh is spotted and streaked with deep crimson. Sometimes almost the whole flesh of the orange is crimson. It has a fine flavor, and is in every respect a first-class orange. The tree is a good grower and thornless.

The Thin-skinned or Paper-rind St. Michael I introduced into this county. It is a small but first-class orange of very fine flavor. The tree is thorny, a good grower and very prolific bearer.

# CHAPTER XXV.

## Seedling vs. Budded Trees.

This was the first subject fully discussed at the regular monthly meetings of the Southern California Horticultural Society, thereby showing it was the most prominent matter needing elucidation by the pomologists of this country.

I can do no better than to give the arguments *pro* and *con* advanced at those discussions. They brought to light the best ideas of the most experienced growers. I have no reason to change the views I then entertained on this important subject. The discussion took place at the April session of the Society, 1877, and was reported substantially as follows in the *Horticulturist:*

"T. A. Garey opened the discussion by exhibiting a great variety of budded fruit. It would pay to bud the orange, the same as it pays to raise fine fruits of other varieties, or fine stock. All fine fruits are at first the result of accident. The fine varieties are propagated by budding or grafting. A thousand peach pits would produce numerous varieties of the peach, but only one tree of the lot might be worth perpetuating. The same rule applies to the orange, though not to so great an extent. The orange more nearly reproduces itself from the seed than any other known fruit. Good seed, or seed from good oranges, will generally produce trees that will bear good fruit, but not always. Nurserymen generally get seed from the poorest oranges, because they contain more seeds; but these seeds will produce trees that will, unless budded, bear an inferior fruit. He exhibited a Mediterranean Sweet as being certainly a good fruit. It will pay to bud the orange, even though the best varieties be no better than the best Los Angeles oranges. Wolfskill's

Best is a very superior fruit. If trees be budded to this fine variety the fruit will be equally good. We send too many poor oranges to market. Were all oranges as good as Wolfskill's Best, the market would be much better and prices would rule higher. Mr. Childs can show accounts of sales of oranges in San Francisco, when some lots of fine fruit brought forty dollars per thousand, while other lots brought only ten dollars per thousand on the same day; therefore it would pay to bud the orange, even to the best Los Angeles seedlings. Early fruiting is one advantage of budding. Budded trees produce fruit three or four years earlier than seedlings. He showed four oranges taken from a tree that will be four years old from the bud next month, and the bud was put on a two-year-old China lemon root. The tree produced about sixty oranges this year. It has received no extra attention. It produced fourteen oranges last year, and two oranges two years ago. This variety (the Mediterranean Sweet) is a fine large orange, and the tree is almost entirely thornless. A Florida horticulturist had taken the position that it would pay to cut thorns from the orange tree, in order to save the fruit from being punctured and ruined. The fruit of this tree is not damaged from this cause. About one-half of the budded fruit contains no seed. It is not yet known whether or not the budded orange will bear transportation better than the seedling, but the fruit is solid and finely organized (of the Mediterranean Sweet), while the seedling is more spongy, especially late in the season. The question as to whether the fine varieties are dwarfs or not, is an important one. A six-year-old Mediterranean Sweet on China lemon root measures seven feet in hight, and is otherwise as large in proportion, showing no signs of being a dwarf. An imported tree, six years old, is seven feet high, from six to seven feet through the top, and the branches come out one foot from the ground. It produced more than one hundred oranges last year, all of which were large and fine.

"The following estimate was submitted: Plant two-year-old budded trees, about seventy-five per acre. In four years from the bud, or two years from planting, the trees will bear from fifty to sixty oranges each. At one cent each they will yield

from thirty-seven dollars and a half to forty-five dollars per acre; at five years from the bud, or three years from planting, seventy-five dollars; and the next year one hundred and fifty dollars per acre, or a total of more than two hundred and sixty dollars in three years. An orchard planted to seedlings, four years old, will seldom produce any fruit in three years from planting.

"An acre of four-year-old seedlings will cost, at twenty-five cents each, eighteen dollars and seventy-five cents; an acre of budded trees, at one dollar each, will cost seventy-five dollars; difference in favor of seedlings, fifty-six dollars and twenty-five cents. The first three years of return from the budded orchard will pay the difference and leave a balance of more than two hundred dollars in favor of buds."

It may be proper to remark that prices of trees fluctuate, and that there is not now the relative difference between the cost of seedlings and buds that there was at the time of this discussion. There has, however, been but a small percentage of the buds offered for sale that were in every respect what could be truthfully called *first-class*. Probably the want of a proper knowledge of the best season of the year in which to bud, and the management of the buds while in the nursery, has been one of the principal causes, if not *the* cause, of there having been so many inferior buds.

[Since the time of this discussion I have come to the conclusion that twenty feet apart is far enough for buds, which distance would require one hundred and eight and nine-tenths per acre, to be exact.—AUTHOR.]

Dr. Congar, of Pasadena, opposed budding. He said budding had been abandoned in Lower California; that they even plant the seed where the orchard is to stand, thus saving the tap-root, which is essential. The public demand a large orange; they do not care so much for its flavor. If a growing tree bears early, the fruit is produced at the expense of the growth of the tree. Will a tree thus dwarfed ever be as large as a seedling that more nearly gets its growth before fruiting? We must have a tree before we can get the fruit. He considered the budding of the orange an experiment, and was willing to let "well

enough" alone so long as Rose and Wilson can raise as good oranges as they do at present. All budded fruits are dwarfs, deciduous fruits not excepted. In conclusion he favored large fruit, regardless of quality.

Mr. David Lewis exhibited a large orange, grown on a seven-year-old seedling.

Mr. Richardson, of San Gabriel, gave an account of a seedling that bore a few oranges at seven years of age, and one thousand at nine years.

Dr. Edwards argued against the idea that budded trees are short-lived; the root, being seedling, supplies the growth proper.

Mr. Fisher has Mediterranean Sweet buds, one year old, in bloom this year, on two-year-old roots.

Mr. Garey spoke, by request, of the Malta Blood. One traveler would describe it as being a blood-red orange. Others say one orange will be entirely free from the blood red, while another will be spotted and streaked with it. He cut an orange streaked with red.

J. De Barth Shorb's remarks: "Will budding the orange pay? is a question involving results of so vital importance to our orange-producing interests, it has concentrated the attention of our leading orchardists, causing some misgivings, and inducing a thoroughness of inquiry in the matter; and I am sure this inquiry will result in great good.

"Orange cultivation is still confined, practically and commercially, to a very small part of the world, though it can be extended over a much larger area.

"According to Gallesio and Bentleam, the orange is a native of tropical India, was introduced into Arabia, and thence into Spain sometime during the eleventh century; and from Spain into all parts of the world where climatic conditions render its cultivation possible.

"It will be seen, therefore, that orange culture has been confined principally to countries in which nature has been most lavish in dispensing the natural blessings and resources — so lavish as to have made their fortunate inhabitants satisfied with conditions as they found them, leaving nature to work out her own problems and processes without their aid.

"That restless energy and ambition, characteristic of Americans, to improve every branch of industry they may adopt, are dormant with such a people; and from them, or at least from their records, we have no reliable information as to any efforts they may have made to improve the different species of the citrus family. The culture of the orange is, relatively speaking, of recent growth in our own country and with our own people. We are therefore compelled to judge more from analogy than from any positive data obtained from experiments. The production of new varieties in all horticultural branches, and the improvement of those already obtained, is a science yet in its infancy, and it must remain more or less empirical for years.

"Time is the great essential element in the prosecution of this science. Unfortunately for us, years have to elapse before results can be obtained to test the correctness of the judgment directing the experiments. The grafting and the budding knife have thus far been found to be the only sure means of reproducing and extending chosen varieties of fruit.

"Years of experience have taught us that the planting of seed of chosen varieties, to reproduce the same, results in failure. Sometimes new varieties, better than the parent stock, are produced. They are almost always inferior, or, if not, produce an entirely new variety of fruit.

"It is true that nature, in her mysterious process of mixing the pollen of blossoms, has given man the finest varieties of all the fruits; these he has perpetuated by budding or grafting.

"This strong tendency to hybridization of the species of all fruits is more especially noticeable in the citrus family. According to Risso and Paitearo, monstrosities are often the result of hybridizing the citrus family—a strong warning to the 'seedling' advocates. If I may be pardoned for digressing, do we not secure in this wonderful process of creating new varieties in the tree family a strong argument in favor of the human development theory advocated by those master minds, Spencer, Darwin and Tyndall? 'Natural selection, and survival of the fittest,' seems ever to be the forming principle of trees.

"The apple tree may safely be taken as a guide in judging from analogy the results of budding the orange.

"Many authors tell us the original apple was an Egyptian crab—a fruit of so abominable a nature we can readily understand how it came to stick in Adam's throat, and refuse to go down. We are caused no little thought over the natural perversity of woman, who would barter all the joys of a Garden of Eden for a taste of a *crab apple!*

"From this stock as a basis horticultural science, with nature's assistance, has given us all the varieties of magnificent apples we enjoy to-day. The orchardist, with his grafting knife, joins a small scion from four to six inches long to a shorter piece of root, always obtaining the same variety as that of the scion used.

"Surely there can be no one at all acquainted with the orange, or who has closely observed the products of his trees, that has not noticed a marked difference in the fruits, even of a small orchard of seedlings. Some trees are bound to produce better oranges than others, with the same care and cultivation. If we select and perpetuate the fittest of the apple, peach, etc., why not pursue the same course with the orange? I say, unhesitatingly, we have no marked difference in the orange family, in the general laws governing and directing all trees.

"I believe a recent French author, whose work I have not had an opportunity to read, claims to have made a specialty of the study of the habits and conditions affecting all the species of the citrus family. I think I am correct in saying that his principal objection to budding is that it has a tendency to dwarf the size of the trees and diminish their productive powers. This may be a strong objection in countries in which the soil and climate may not be so favorable as our own, and in which the tendency is to underbear. The tree almost invariably overloads with fruit with us, and, consequently, fails to grow them all large; hence no stronger argument than the preceding can be used in favor of budding. Let us adopt and pursue a policy or process that will give us fewer in numbers, but larger and better in quality, then we can always command the orange market.

"The time is not far distant when the production of oranges will be enormous in this country; when other markets will have to be sought to consume our surplus. We can then hope to

sell at remunerative figures the oranges of only the best varieties. To obtain these, budding is our only method.

"Time alone can determine whether budding shortens the life of orange trees or not. But, granting that it does, will the fact that it causes them to fruit earlier not more than compensate for this?

"Nearly every orchardist would succeed, even with very limited means, if his trees could be made to yield him a return in three or five years, but who would go down to ruin and into bankruptcy were he compelled to wait from seven to ten years for his income. I believe it is universally recognized that budding shortens the period before fruiting. Is not this, then, a strong reason, financially, why we should adopt the budding system? Leaving generalities, my own experience teaches me the necessity of budding. I can see no dwarfing tendency or results; on the contrary, my budded trees are larger than seedlings of the same age, and the fruit is certainly as good. I have not been able to observe that the production is fewer in numbers.

"I will say, in conclusion, that budding enables us to grow a uniformly good fruit, not otherwise obtainable, of different chosen varieties. It shortens the time before fruiting, and relieves the orchardist of several years of care and expense, and, oftentimes, grinding poverty. Meanwhile it cannot work any detriment, except, possibly, to shorten the life of the tree, and this is otherwise compensated for. I therefore give my unqualified opinion that it will not only pay to bud the orange, but that, as intelligent men, we cannot afford to do otherwise."

Mr. L. J. Rose believed budding might be a good thing, but he did not consider it of so much importance as Mr. Shorb did. He does not think the comparison between the apple and the orange a good one. It is true that budded trees do not grow so large as seedlings, or yield so many oranges per tree.

Mr. Berry said he would be willing to endorse budding if he could see as good oranges from a budded tree as Messrs. Rose and Wilson's best seedlings.

Mr. Rose stated that as the trees become older, the skin becomes thinner, and the oranges better. Trees on clay or stiff soil, in his locality, did not produce oranges so sweet as those

grown on gravelly soil. Trees that overbear one year will produce poorer and sourer oranges the next. There is no difference in the fruit of seedling trees under similar conditions.

Mr. Shorb disagreed with Mr. Rose. He found some trees bearing good fruit, and others poorer fruit, under the same conditions. He favored budding on orange stock.

Mr. Berry presented two fine seedling oranges from a tree nine years old, twenty-three feet in hight and seven inches in circumference, and desired to have them compared with the best budded fruit.

Mr. Barrows agreed with Mr. Shorb, that localities and quality of soil have their influence on the quality of the fruit, no matter what kind is planted. He has in his yard an orange tree twenty years old, that has borne bitter fruit, owing to its unfavorable surroundings. He claimed two advantages for budding. Trees should be budded at two years of age, or three at the most. The trees will fruit earlier, and the fruit will be uniformly better. They worked ten years in Australia to find they were raising poor, sour oranges. They then turned their attention to budding, and have universally practiced it since.

Mr. Kercheval stated that his trees, from which Mr. Berry obtained the oranges he exhibited, bore about two hundred oranges each last year, and about the same number this year; that they are now twenty-three feet high, seven inches in circumference, and are only nine years old. He had forty-five trees of the same age, only a portion of which had commenced bearing.

Mr. Rose had seven hundred trees, six hundred of which bore at eight years of age. The seedlings of Los Angeles county were raised from seed of Tahiti oranges, which are of a pale yellow, but they are of a dark orange color here; hence, climate, soil, etc., make the quality of the fruit.

Mr. Woodhead had seen Mr. Kercheval's trees, and he considered them the finest in the county. He saw no reason why they should have made an unusual growth. In different parts of the United States, different varieties of the apple take the lead. The White Winter Pearmain takes the lead in this county, but probably with the exception of California, it does

not take the lead in any place in our country. The same rule may prove true in orange culture. We may yet get a variety, if we have it not already, that will take a decided lead.

This question was propounded to Mr. Rose:

If you were putting out an orchard now, would you plant the budded tree?

He did not know. He was opposed to budding, as it stunted the tree and caused it to bear early, and, as he thought, making it short lived. The orange reproduced itself from the seed, thus differing from peach and apple. He had shipped his fruit to New York this year, and was informed, when returns were made, that his oranges were the best to be had in that market. He preferred the seedlings, even though he had to wait longer for the fruit.

Dr. Congar stated that the Florida seedling was the best orange he found in that State. In Nicaragua he ate a seedling orange which was of a grass-green color when ripe. He believed the color was owing to the locality. He was budding orange on lemon and lime, but expected to find a hybrid, instead of either lemon, lime or orange. The Los Angeles seedling orange is being shipped to Salt Lake City, and it is there pronounced the best orange in that market.

Mr. Berry believed that the seedling orange's coming into bearing late is owing only to poor cultivation.

Mr. Garey was not opposed to the Los Angeles seedling oranges, but he favored budding to the best varieties of seedlings as well as imported varieties, so that the fruit may be universally good.

Captain C. E. Thom thought the absence of thorns on the orange a strong argument in favor of budding, and that a large percentage of the fruit of seedling trees must be lost from being punctured by thorns.

At the July session of the Society, Will it pay to bud the orange, and will it pay to bud bearing trees? were subjects discussed.

Mr. Rose said, in substance: "There are many who think grafting or budding is in some way an improvement in the fruit. This, of course, is not so. It is only a means by which some

other variety may be propagated with certainty and multiplied rapidly. Under favorable circumstances each bud will become a tree. Budding does not, in itself, change anything. If a bud be taken from a tree of an inferior fruit, that inferior property will be propagated; if superior, then there will be an improvement. It follows, then, that there must be a better variety to bud from, or there will be no improvement. The important question then arises, have we a better orange than the seedling? I have extensively examined many varieties, and have carefully observed and studied the seedling, but I have failed as yet to find one better than the Los Angeles orange, or, of budded varieties, equal to it. I have found no marked difference among the Los Angeles seedlings. I find a difference in fruit of different localities, even in those very near together—say within twenty feet. There is always a difference, however, in the soil, or the exposure of the tree, it being less crowded, or sheltered from wind, in its water supply, or its general health—which can be seen by the careful observer. Overbearing, or the reverse, and the age of the tree have a marked effect upon the fruit.

"The advantages of budding the orange are illustrated by many by reference to the peach, apple, pear, etc., but there is no analogy between them. If seeds be planted of any of the above-mentioned deciduous fruits, they will come in all varieties, and almost all inferior to the standard varieties of these fruits. The standard varieties are the production of centuries of selection. They have been originated from a very inferior parent. This has not been the case with the orange. The Tahiti orange, or the Mexican orange from Acapulco or Panama, is the same as the original fruit, as nature produces it in its native woods. Both of these are the parents of our oranges. Both of these are yet very different from the Los Angeles, even to the eye. Both have a lemon-colored and much thinner rind; while one is oval, the other is round; yet, when the seeds of these oranges are planted here, the product (the Los Angeles orange) is very different in flavor and appearance. The rind thick and rough, and red in color; the flavor of the orange has more acid with ts sweet (very different from the insipid sweet), and it is of a much higher quality and aroma. All this would prove that

climate and locality make the appearance and quality of the orange. There is no doubt that this is true, for each country has some marked difference from other countries in the appearance and quality of its fruit. The Florida is different from the Cuba; that, again, differs from the Mexican, and so on. The Los Angeles orange more nearly resembles the Mediterranean orange than it does any other; and, from what I understand, there is in soil and climate a great similarity between Los Angeles county and the country producing the Mediterranean orange.

"To improve the Los Angeles seedling oranges, produced in our best localities, seems to me like gilding refined gold. My interest lies in the direction in which knowledge upon this subject is of importance to me. Having had superior opportunities to make comparisons, my opinion is entitled to some consideration. I have also tested the judgment of others, having sent oranges to New York, Chicago and Boston, and to England, to persons who can give an intelligent opinion—even to Marshall Wilder—and there is but one opinion of our orange, when fully ripe: *The best orange we have ever eaten.*

"There are some circumstances under which it is desirable to bud the orange. There are some varieties that bear abundantly when young. By budding from these varieties, the beginner in orange culture can have fruit early. Budded trees are adapted to small places in town, as they are not likely to grow to be large trees. One of these varieties, which Mr. Garey names the Mediterranean Sweet, is a very good orange. If grown under more favorable circumstances, and in a favorable locality, it might be equal to the best Los Angeles seedling. It has, too, the advantage of being almost seedless and thornless; but to plant it largely for an orchard and for long usefulness, as compared with the Los Angeles, would be an experiment in which I have no faith.

[The Mediterranean Sweet oranges exhibited by me, and to which Mr. Rose refers, were raised in the City of Los Angeles. The oranges of this city cannot compare, in point of excellence, with those of the San Gabriel fruit-belt and of other favored ocalities.—AUTHOR.]

"It is a fact that a seedling tree has a longer limb, is hardier and healthier than one that is grafted or budded.

"I believe in experimenting in all things. That improvements will be made by selecting from our seedlings is almost certain; but that this improvement will be very slow, is, in its very nature, certain, for our orange is an original type. It has as yet no inherent variation in its nature. To get the first disposition to part from its original type will be difficult, and it will be but slight at first; but perseverance will in time doubtless receive its reward. Again, it is much more difficult to improve a good fruit than one of very ordinary quality, and it is not easy for me to conceive in what direction our orange, grown in the best localities, can be improved. I would demand something more than fine specimens, which are very deceptive, to induce me to plant largely of any new variety. I would first wish to try them in a small way for a considerable length of time.

"Time will be required, too, in which to determine what stocks will be the best, for the stock has a marked influence upon the bud or graft. I have say one hundred and fifty orange trees budded upon the China lemon. At the time of taking the buds the tree from which they were taken had the largest and best oranges. All of these trees bore some three or four years earlier than other trees not budded. The oranges these trees bear have a thicker rind, are more acid, and the pulp is a lighter yellow and less juicy (more pulpy). The size of the orange is, perhaps, a little larger, but the increase in size is owing wholly to the increased thickness of the rind. The tree is now much smaller than the seedling of the same age, and, consequently, bears fewer oranges—a difference which will continue to increase. The buds were all taken from one tree, yet the oranges on the different trees, and in different years, are as various as are those of my seedling trees, owing to difference in soil, fullness of bearing, etc. Then, again, they bore early—earlier than seedlings—not because they were budded on a stock whose nature it is to bear young, but because the stock, being of a smaller and slower growth, checked the flow of sap; and this is favorable to the development of fruit buds rather than of woody

growth. Had this budding been done on a seedling orange, and seedling buds been used, the difference in earliness of bearing would be little, if any—certainly no more than like pruning to the stock would make. It is a well known fact that the continued excessive pruning of a tree will dwarf it and cause it to bear early. Pruning is at best only a violent remedy, and when standard trees are wanted it is useful only so far as it is necessary in order to plow. The less pruning the better, provided the trees have plenty of room. But I am digressing from my subject. I wanted to show what effect the stock had upon the fruit, in my experiment, and that the early bearing was owing to the dwarfing of the tree—the influence of the smaller stock. On the other hand, take a seedling stock and use a bud of an early-bearing variety—one of a small growth, a dwarf habit, and the result would be early-bearing qualities, with, perhaps, some thrift from the seedling stock. I believe all early bearers of the orange family are of a dwarf habit."

Extracts from Mr. Garey's remarks: "This question is of more than ordinary importance. It lies at the foundation of successful orange culture in this country. The necessity of solving the question becomes apparent when we consider the interest of the many engaged in the business, and of those who will yet engage in it, many of whom have invested or will invest their all upon its promises of future reward. It cannot be denied that orange culture is now one of the leading industries of Southern California, and that it will so continue is beyond question. It behooves us, then, to start right, so that when our orchards begin to fruit the product will be of a uniformly good quality, of a class that will be in demand, and that will enable us to compete with oranges from other portions of the world. Orange culture is prosecuted vigorously, not only in Australia and in other countries across the ocean, and upon many of the islands, but Florida, Mississippi, Louisiana and Texas are producing this fruit in great abundance, or are preparing to do so. Look around us here and see how fast our orange orchards are increasing in numbers and extent. Fifteen years ago the Wolfskill orchard of two thousand trees was the largest in the county. Now the Coöperative Nursery and Fruit

Company, of this county, have an orange orchard of seven thousand five hundred standard trees that are now from six to seven years old. Twenty years ago, at the Mission San Gabriel, the padre's orchard of a few dozen trees at the Mission, and a like number on the grounds of Hon. B. D. Wilson, constituted the orange orchards of that locality. Now the extensive orchards of Messrs. Wilson, Shorb, Titus, Rose, Kewen, Chapman and others are prominent. They and their neighbors are planting new orchards yearly, and some of them larger ones. At Orange, Riverside and other places almost every man has his orange orchard. At Pomona the settlers all plant orange orchards, and the Pomona Orchard Company now have an orchard of sixteen thousand trees, nearly all orange, lemon and lime. What does all this mean? It means that our people have faith in this portion of our country, its future and the future of this business. The result will make independent all engaged in it, if they will produce a fruit that can be classed A No. 1. If they do not, no prophet will be required to predict the result. There is no question in my mind in regard to the success of the business, provided we produce a first-class fruit. The quantity produced will create a demand for the same, provided its claims as to size, flavor, shape and color be of a character that will enable us to compete in the markets of the United States with fruit raised in other countries, and especially with that produced in other sections of our own country.

"A proposition has already been made by the *Florida Agriculturist* to invite our Society and the Horticultural Societies of Florida and Louisiana to unite in a grand display of oranges and limes at Washington, next February or March.

"It is easy to predict the result of such meetings. If horticulturists of Southern California won the grand prize, it would give our fruit an enviable reputation throughout the civilized world. If they received an inferior prize, or none at all, the effect would be apparent.

"How can we attain to perfection in our orange, and maintain that perfection, is suggested. I answer, only by propagating our best types, native or foreign. It is the only safe, consistent, intelligent and progressive method upon which our people can

start an orange orchard. We cannot afford to take chances any longer. The man who buds his trees, and who is careful in the selection of his buds, will reap a golden harvest; but he who depends upon the caprice of nature will repent of his folly when it will be too late.

"Extract from the *Florida Agriculturist*, April, 1877, taken from a report of the Florida Fruit Growers' Association on the nomenclature of the citrus family:

"'Seedling oranges differ in quality, and in order that Mediterranean and West India fruit may be excluded from our northern and western markets, none but the best varieties should be propagated, cultivated and marketed, as is done with apples, pears, grapes and other fruits. When the finer varieties of oranges shall have been named, propagated, planted in quantity and carefully and honestly marketed, they will be purchased as particular varieties, and not as the mixed product of any particular grove or locality. If such a course be pursued, fruit possessing superior qualities, and sold under distinguishing names, will be sought after, and will command remunerative prices; while mixed samples, unknown and inferior varieties, will become a drug in the market, and will not pay commissions and cost of transportation. We feel assured that orange growing must be placed on the same basis as apple and pear culture, and the fruit marketed under known, distinguishing and specific names, so that a name shall be a guarantee for certain qualities or properties, as is the case with other fruits.

"'Your committee were selected by the Duval Agricultural Society to judge the fruit at the late fair. They took advantage of their official position to examine and test the fruit from various sections of the State. Their researches established the fact that locality exerts less influence, as regards the quality of oranges, than is commonly supposed. It is a generally received opinion that the oranges of Indian river are noted for their thinness of skin and sweetness and lusciousness of juice. Your committee were requested to examine and name a variety of orange from a grove on Indian river. An examination revealed the fact that the fruit was very acid, and the skin the thickest of any on exhibition. Some very superior varieties, grown in

Orange county, were exhibited, yet one sample entered for competition was the poorest fruit your committee ever tasted; and they are convinced that locality has less to do with superiority than variety has, and they would urge the importance of the more extended culture of known, named and superior kinds. When this shall have been done, Florida fruit will exclude from our markets the Mediterranean and West Indian products, and the excellence of some particular named and recognized variety will cause them to be sought after, as is the case with other fruits. The packing and sending to market of good and bad varieties will injure the reputation of our State as an orange-producing region, and place it upon an equality with the Mediterranean. Those who possess seedling groves, or those who raise sweet seedlings for sale, may object to this doctrine, but it is supported by the experience of all fruit-producing regions. Excelsior should be the motto of every one engaged in the production of the golden fruit.

"'It is to be hoped that our nurserymen will secure and cultivate none but named, recognized and superior varieties, in order that future planters may take advantage of the experience and labors of others. Like the peach and the grape, the orange varies from seed, and in a seedling grove varieties of almost any quality will be found; hence, the necessity of planting recognized varieties when they are grown for market, as is done with other fruits.

C. J. KENWORTH,
A. I. BIDWELL,
G. W. DAVIS, *Committee.*'

"Mr. George W. Atwood says, in a letter to our fellow-townsman, Mr. T. C. Severance, and dated June 18th, 1877, at St. Augustine, Florida:

"'Do not let any man, or number of men in pomological convention, induce you to adopt the plan of establishing a seedling orange grove, for if you do, you will awake some of these fine days from a Rip Van Winkle dream and find yourself as far behind the age and times as he is represented to have been. No two seedling orange trees will ever produce fruit exactly alike, and your fruit will become promiscuous and variable in character and quality, while others, having select and uniform

varieties, will find a more ready demand and sale at fully fifty per cent. advance over those shipping only promiscuous and variable fruit. Besides, budded trees fruit much earlier. Certain standard varieties of the orange are remarkable for their fruitfulness, as well as for their excellence of quality. We choose such for propagation, rejecting all others. We invariably get fruit in four years from the seed, and, seven times out of ten, in three years from the seed; that is, we bud on two-year-old stocks in May or June and get blossoms and fruit in the following year.'

"This experience is corroborated by my own in this county. Again, he says:

"'Seedling trees are generally eight, nine and ten years coming into bearing, and while we get only twenty dollars per thousand for them, we get from forty to fifty dollars per thousand for our select varieties. They are nearly twice as fruitful as the seedlings, and in many instances produce four times as many. We bud Navel, Blood, St. Michael and Mandarin. Our Sugar Sweet usually requires two years from the bud in which to fruit. The sooner your California fruit growers understand this, the better it will be for them.'

"It appears to me that Mr. Atwood has told the story, and solved the problem, 'Will it pay to bud the orange?' in a most masterly manner. It is evident that the people of Florida have found out, to a tune of fifty per cent. or more, that budding the orange *pays*, and I think we of California will soon learn the same lesson, if not by precept and example, by sad experience.

"We have in our orchards specimen seedling trees bearing oranges equal, perhaps, to the best oranges of Florida or any other country. With these let us establish a reputation for our fruit, and maintain that reputation by multiplying these varieties by budding our young orchards. We also have imported varieties now fruiting, of large size and uniform quality, of fine, agreeable flavor, splendid deep orange color and symmetrical in shape, that are not only early fruiters but regular and heavy bearers, paying from the commencement. The trees are also almost entirely thornless, and of handsome shape and habit of growth. The Mediterranean Sweet, a variety that I have fruit-

ing, is of excellent quality. I now have thousands of this variety in nursery, and I find that all that are fruiting maintain in every instance the characteristics of the parent tree. Whether budded on orange, China or Sicily lemon, makes no difference; the peculiarity of absence of thorns, etc., and other marks of individuality are maintained throughout. The absence of thorns is no small advantage in the cultivation of the fruit. I believe it is conceded that a large proportion of what are known as *windfalls*, also the greater part of all that rot soon after packing for transportation, are caused by the puncturing of the fruit by thorns.

"Then another reason why it will pay to bud the orange is, that we may have orchards without thorns; this is a desideratum of some importance, at least in windy districts.

OBJECTIONS BRIEFLY CONSIDERED.

"Objection number one—'Budded trees are short lived.' How is this known? Who is authority on this point? It is in evidence that the oldest budded trees in this county are vigorous and sound. Seedlings are sometimes short lived. The same cause that shortens the life of a seedling would shorten the life of a budded tree. The root of a budded tree being seedling, it is difficult to imagine how the process of budding affects its longevity.

"Objection number two—'Budded trees are dwarfish.' This proposition has not thus far been borne out by facts. This objection, as well as the preceding, is only a theory. Mr. Shorb stated at one fruit meeting that his budded trees were larger and more vigorous than seedlings of the same age. My own experience is of the same character. My budded trees are large, exceedingly thrifty and vigorous. Some varieties are of slower growth than others. My Mediterranean Sweet and St. Michael are more dwarfish in their habits than the Acapulco, Konah or Los Angeles seedlings; but even those varieties are as large as seedlings of the same age. But if budded trees be somewhat dwarfish eventually, it will not be a serious objection, simply necessitating more trees to the acre, thus practically neutralizing the objection.

"It depends on circumstances whether or not it will pay to bud bearing trees. If the fruit is small, sour, or inferior from any cause, it will pay to bud.

"I will remark, in conclusion, that in all civilized portions of the globe in which orange culture has attained any degree of prominence, budding is universally adopted; and if we neglect to bud our orange trees, and to maintain a high standard of excellence for our fruit, I sincerely believe we shall fail to compete with other orange districts; that our orange growing will necessarily decline; and that we shall sink into insignificance, to the utter ruin of all engaged in the business. I believe, on the other hand, that if we bestir ourselves, as we should do, profiting from our own experience and that of others, this interest will attain colossal proportions, second to none in the land; and that it will induce immigration, resulting in the filling up of our peerless valleys of semi-tropical California with prosperous, happy and well-to-do people."

Mr. Rose claimed to be progressive, although to oppose budding may appear to some to be putting the brake on the wheels of progress. The orange, unlike the peach, etc., comes true to seed. He thought when his first orchard began to bear, some trees produced a superior fruit, while others bore an inferior fruit. Time proved that all trees bore the same quality—soil, culture and other conditions being equal. Each kind of soil will produce a different kind of orange, and budding from one kind of soil to another will not perpetuate the exact quality of fruit. Soil, culture and freedom from winds all have their effect upon the quality of the fruit. One side of the tree, exposed to the prevailing winds, will produce a very inferior orange, and few in number, while the sheltered side of the same tree will bear first-class fruit. If we have a better fruit than the Los Angeles seedling, then bud; otherwise, not.

Mr. Rose referred to the extract from the New York *Evening Post*. The *Post* stated that from only one place in the United States did it receive better oranges than those raised by Mr. Rose at San Gabriel. He has budded trees on China lemon roots that have been bearing for ten years. The fruit does partake of the nature of the stock. They do not produce near so

many oranges per tree as seedlings of the same age, and as the trees grow in age the difference increases in favor of the seedling. No one knows that the budded orange tree is shorter lived than the seedling, because the orange is a long-lived tree; but other budded trees are shorter lived than corresponding seedlings; hence, he argues from analogy that the budded orange tree is also shorter lived than the seedling. The Florida argument is not good, because they bud everything there, taking the wild, sour orange from the woods as the stock on which to work. They must bud it, because it is worthless without. Here it is different. He does not think the budded tree will produce a fruit more nearly uniform than that of the seedling. All trees will produce some good and some poor specimens of fruit.

Mr. Frye, Superintendent of the Wolfskill orchard, stated that one tree in that orchard bore a very large fruit of excellent quality, while adjacent trees bore the ordinary seedlings. Trees budded from that tree all produced the same fine quality of fruit. He could discover nothing in the soil or the surroundings of that tree, or of those budded from it, that should cause the superior fruit.

Mr. Messenger thought a stranger, listening to the discussion, would come to this conclusion: "There appears to be a difference of opinion in regard to budding the orange. It seems that a man can put out an orchard of budded trees, and realize an income from it in two years, while he must wait five years for returns from an orchard of seedlings. I shall therefore put out a budded orchard, and then study this question at leisure."

Mr. Blanchard, of Ventura, stated that the Horticultural Society of Florida had translated and published a French work on the citrus family written fifty years ago by Gallesio, in which the author took the same ground, relative to budding, as that taken by Mr. Rose. Budded trees in full bearing would produce from fifteen hundred to two thousand oranges per tree, while seedlings would produce from two thousand to five thousand, and he gave one instance in which a tree had borne eight thousand. The seedling tree bore uniformly good fruit, influenced only by soil, climate and location.

Mr. Garey replied that Gallesio's work was no argument for

the present day. The Florida Horticultural Society may have found enough good in it to warrant their publishing it, but they entirely ignored the non-budding theory of the French author.

Mr. Garey cut and exhibited one of his Mediterranean Sweet oranges. Its size was a full average of our Los Angeles orange, quality excellent, symmetrical in shape, and deep orange in color. It was also firmer than our common orange at this season of the year; and, to sum up, it combined all the good qualities possible in any variety of fruit.

# CHAPTER XXVI.

## How to Bud.

The third year from the seed is the best age at which to bud orange trees. Small plants, two years old, and even some one year old, *can* be budded successfully. They can be budded successfully at almost any age. Budding may be done at times from March to November, but early or late budding is the best. I have found April and May to be the best months for early budding, and October and November for late budding, the latter remaining dormant till the following spring, usually commencing to grow in April, but sometimes as early as January. Buds inserted in April generally make a substantial growth the same season. Buds inserted later in the season, say in July and August, make but a small growth and do not mature sufficiently to resist the occasional cold weather of our winters. Even in favored localities that are generally free from frost, it is not desirable to start the buds late in the season. They never make so satisfactory a tree, besides it is more work to take care of them, they being inclined to make a low, insignificant top. A bud that is strong and vigorous at the start will usually continue so, and make a tree that will be satisfactory to both grower and purchaser, and *vice versa.*

The stock must be in good condition at the time of budding; that is, the sap must flow freely; the tree will then be in a vigorous growing condition, and, if the budding be skillfully done, it will be a success. It is safe to say that, under the conditions above mentioned, a skillful budder will succeed in getting ninety-five per cent. or more to grow. To test the stock, make an incision through the bark; if the sap ooze out, and the color of the wood be a dark green, the tree will be in the best possible condition to bud.

The proper selection of the buds is of great importance. Select the matured wood of the last growth of the season, or the next to the last. The branches should be well rounded up, and the buds full and plump. The growth yet sharp and in triangular shape may be used when material is scarce, but they are not so certain to grow as buds cut from well-rounded wood. The buds should be in a dormant condition, being best when they are just ready to start. Immediately after cutting a stick of buds remove all the leaves therefrom, cutting them off within one-eighth of an inch of the bud. Put them in convenient bundles for use, then put them into boxes, which should then be filled with sawdust—enough at least to cover the buds after shaking so as to fill all the interstices well. Dampen thoroughly and the buds will be in condition to keep in the best order for a sufficient length of time to be used, and even to bear transportation. I have shipped them to Florida, the buds arriving in good condition. They may sometimes be kept two weeks in cool weather.

The budder uses a budding knife, as "sharp as a razor." The best style of knife is one that has a small thin blade, with a handle made wholly of bone. Take a small bundle of sticks, carrying them for convenience in a small box of damp sawdust. Budders sometimes wrap their buds in a damp cloth, for use in nursery, and keep them in the shade.

The operator should make a longitudinal and a lateral cut in the tree, the latter just at the top of the former. Cut through the bark, but not into the wood. The former cut is usually made first. With a peculiar motion of the knife, and with the blade slanting downward, the lateral cut should be made in such a manner as to open the lips of the longitudinal cut sufficiently to receive the bud.

Select a stick that conforms in size to the size of the stock to be budded. Turn the top end of a stick towards you. Hold the knife firmly, carrying the blade smoothly through the bark and wood, cutting out a piece not exceeding an inch in length. There should be some wood in the center of the bud. The lower end of the bud should be barely blunt enough to admit of being inserted without doubling

up. The novice usually cuts too deep in cutting a bud, thereby taking too much wood. Having cut the bud, place the lower end of it in the opening made by the lateral cut and press it down gently till the upper end of the bud will be far enough below the lateral cut to allow the bark to be tied well over it. One-eighth of an inch below is ample. The longitudinal cut should not be so long as the bud; then the lower end of the bud will be well under the bark at the lower end of the cut. Be careful not to push the bud to one side of the longitudinal cut; if you do, move it before tying so the cut will be along the center of the bud. Pressing the lower end of the bud under the bark at the lower end of the cut is the usual method in budding any kind of a tree; but it is not so necessary with those of soft wood—the peach, for example—as with the citrus family. Wrap the buds with proper material. Make two turns above the inserted buds and three below; draw the twine firmly while winding, in order to close the bark of the stock as nearly as possible firmly around the bud and to exclude the air completely. In California we use for tying the buds soft-twisted cotton twine of ten or twelve ply. It is strong and can be drawn tightly enough to hold the buds firmly. If the stock be high enough to admit of it, the buds should be inserted about three feet from the ground, that the stock may be saved to form the body of the tree. A skillful budder will insert and tie from five hundred to one thousand as an ordinary day's work. Some experts can bud and tie more than a thousand in a day. As a rule, the more rapid and expert the budder is, the more successful he is in results.

The trees must be watched closely after budding, lest the twine, by the growth of the tree, cut through the bark and injure or spoil the tree. The string should usually be loosened—not taken off—at the expiration of two or three weeks. This is properly and most expeditiously done by cutting through the coils of the string on the side opposite the bud. The string will gradually become loose, as the stock increases in size, and eventually drop off, leaving the bud free. About this time, or as soon as the trees begin to send out a new growth, cut off the stock from six inches to a foot above the bud, the length of the

part above the bud to be governed by the diameter of the stock. The smaller the stock, the closer the cut can be made to advantage. Sometimes the stock is cut off before the twine is cut, especially of spring budding, but not of fall budding. Care must be taken to keep all the suckers off below the bud. The young bud generally takes care of itself, forming a body and top in symmetrical proportions. Occasionally one is inclined to grow crooked and ungainly, when a judicious use of the pruning knife must be resorted to as a corrective. The buds need little pruning—generally none the first year of their growth. The pruning will be governed in after years by the judgment or fancy of the owner.

It is frequently necessary to remove part of the sprouts on the stump above the bud, but not all of them should be taken off. Those on the same side as the bud should be removed, that the bud may grow up straight. Enough of the sprouts that start above the bud after the cutting off of the top should be left to keep the sap flowing; at least till the bud shall have attained a length of six inches or more, depending on the size of the stock. When the buds are from eighteen to thirty inches high (this is also governed by the size of the stock), the stub above the bud should be cut off close to the bud.

# CHAPTER XXVII.

## Grafting.

Grafting can be done successfully, and it is recommended when small or dwarfish varieties of the citrus family are used for stocks, or when large limbs or bearing trees are required to be changed to a different variety.

If the stock be of a small or dwarfish habit of growth, and the grafting be done while the trees are young, the grafts can be inserted in the crown of the roots; then when the trees are transplanted they can be set deep enough for the graft to throw out roots. They will readily do this if planted deep enough, thus becoming, in time, independent of the root of the stock.

The common cleft graft is the usual and best method of grafting the citrus family. After scraping the dirt away from the body of the stock close up to the roots and about them, leaving the crown exposed, cut or saw off the body of the stock almost or quite down to the surface of the roots. Then, with a grafting knife, split the stock, if small, through the middle or nearly so. If large, split one side about an inch from the outer edge. It is well to use a wedge to hold the split apart so as to admit the graft easily. The grafts should be selected with care. Use the matured wood of the last season's growth. The scion should be long enough to contain three buds. Cut away the but-end of the graft with a long tapering wedge shape, and also slightly wedge-shaped on the edge that is to be placed inward or towards the heart of the stock. Press the graft down firm and solid into the cleft, and be careful to have the bark of both graft and stock come in contact with each other at the outer edge, so that the union of the sap may be instantaneous. Now withdraw the wedge—no wedge is needed in very small stocks—and with a

brush apply a good coat of grafting wax to the top of the stock and the lower end of the graft. A good brush can be made of baling rope or common sea grass. Cut off pieces about four inches long, comb out the fibers and tie them fast to a wooden handle an inch in diameter and a foot in length. The heat of the wax does not injure a brush made of this material.

The wax is made of four parts of resin and one part of beeswax melted together and applied quite hot. This fills all the openings, hermetically seals the graft and stock, and excludes rain or moisture. The wax resists the action of the sun's rays. It is advisable, however, to cover the graft with soil, except a small portion at the upper end.

The future treatment of the graft consists principally in keeping the suckers off, to force the flow of sap into the graft. I have found this method of grafting very successful.

Budding has been found to be so much more expeditious and satisfactory than grafting, that the latter has been almost entirely abandoned by nurserymen, unless it be when it may be advisable to overcome the influence of stocks of dwarfish habit. Large trees can be expeditiously and successfully grafted by the above method. The month of March is the best season in which to graft.

# CHAPTER XXVIII.

## Propagating by Cuttings and Layers.

Lemon and citron grow very readily from cuttings. The orange is more difficult to induce to throw out roots, and the lime can scarcely be relied on at all from cuttings. Cuttings are usually prepared about twelve inches long. The best are those cut from new wood not more than an inch in diameter. The usual method of planting is to make a trench from six to nine inches deep with a spade, and place the cuttings about a foot apart in the trench. The trenches should be four feet apart. Two or three inches of the cutting is enough to leave exposed. All the attention they need the first year is to keep the ground well watered and cultivated and free from weeds. The subsequent care should be the same as that of young trees in nursery raised from seed. It is a fact I have proven by experience, that the roots of trees raised from cuttings are comparatively worthless, as compared with those raised from seed. I would advise the discontinuance of the practice of using cuttings for stocks.

Another method of propagating is by layers. This is done by bending down to the ground a lower limb of a tree, covering it with soil, and holding it in place with stakes with notches to fit the layer and driven into the ground. It is a good plan to scarify with a knife the portion of the layer to be covered, as roots will form more readily in consequence thereof. This method of propagation is so slow and tedious it is seldom resorted to in this country.

# CHAPTER XXIX.

## Stocks for Budding and Grafting.

Stocks of seedling orange, lemon, lime, and in some instances citron are used on which to bud or graft the orange. Budding and grafting, being an innovation on the system of culture of the past, are yet in their infancy. It was found in the earlier experiments here that the lemon root, as a stock for the orange, was susceptible of rapid and vigorous growth. This was more particularly noticeable in the growth produced by the China lemon root. Buds inserted in stocks of this kind made not only an extraordinary growth, but soon manifested a disposition to blossom and fruit. The fruit of an orange tree on lemon or lime roots is usually large of its variety. It is thought by experts, however, that the fruit is comparatively coarse, is somewhat inclined to be spongy, and develops an acid flavor so strong and pungent as to be unworthy of recommendation.

It has been found that lemon and lime roots are more frequently and fatally affected with gum disease, spoken of under its appropriate head, than orange roots. Large numbers of lemons on their own roots, and oranges on lemon roots, have become diseased within the last few years, premature death being the result. The mortality is so great in orchards and nurseries worked on these stocks, they are in almost universal disfavor at the present time, and have been generally condemned both by individuals and societies. If lemon be used under any circumstances, it should be the China lemon, as this is certainly the most healthful and durable of any of its type. The lime root is used to a limited extent. Like the China lemon root, it induced a strong and rapid growth and a tendency to fruit early. It is, unfortunately, quite susceptible to the gum disease, as pre-

viously stated. Its natural dwarfish habit is another objection to it. It is thought that this will either dwarf the tree in a few years, or fail to support the top loaded with fruit. It is unquestionably undesirable where high winds prevail to use the lime or China lemon root as a stock on which to bud or graft the orange.

The seedling orange is now generally conceded to be the only safe stock on which to work the orange or lemon. Its roots are large, strong and healthy, and are intended by nature to support a stately tree. It is seldom affected, if ever, with the gum disease, or any other disease. The orange has a truly natural affinity upon this stock, and the lemon adapts itself congenially and harmoniously to this stock.

Lemon trees on orange roots are giving universal satisfaction. It is claimed by some that the orange stock slightly diminishes the quantity of acid in the lemon; but this objection is of secondary importance as compared with the health and permanence of the tree.

The orange is in every respect a standard tree, and upon this ground it is to be preferred. It is more hardy than the lemon or lime, and for this reason alone it is decidedly preferable. There are several instances on record in which the lemon has succumbed to the unprecedentedly cold weather of the past two winters, while the orange root, in the immediate vicinity, escaped unharmed. Taking all these things into consideration, I unhesitatingly recommend the exclusive use of the orange root for propagation.

There are some who still contend for the China lemon root, asserting that it is superior to all others, but they are vastly in the minority. A few years hence, after the investigations of the present shall have been more fully established, they, too, will discard the lemon root, and accept the general decision that the orange root is the best.

The following is from a letter written by Ex-Gov. John G. Downey, of Los Angeles, February 19th, 1879, to Dr. J. R. Crandall, of Auburn, Placer county:

"The orange is a long-lived tree, as are all trees that are a long time in maturing. This rule applies to the animal and

vegetable kingdoms. The orange has a powerful and vigorous tap-root, and, I take it, is necessary to its healthy existence in all periods of its long and useful life. The Chinese lemon will not furnish it; nor will it furnish the healthy and complicated frimbia the orange requires.

"The Chinese lemon is, as you suggest, of a rapidly maturing nature. The slips grow as rapidly and as readily as those of the willow. I have had them bear bountifully from the slips the same year in which I planted them. They attain a certain hight, and then remain a shrub of an ungainly character. The orange, in trunk and branches, is a beautiful and stately tree, and is a thing of beauty to the eye, to say nothing of its fruit. I have no orange trees for sale"

J. M. Stewart, of Los Angeles, to Dr. Crandall, February 18th, 1879:

"I can say that the opinion here is universal in favor of the orange root on which to bud the orange."

A. J. Cooper, of Los Angeles, wrote, February 15th:

"Oranges budded on the lemon, or any stock other than its own, would not sell here for anything. All the old lemon trees here are dead or dying. I could have had any quantity of the Chinese lemon on which to bud, for nothing, but I would not take them."

The following explains itself:

"It was discovered some years ago, by some Los Angeles nurserymen, that the Chinese lemon would grow from cuttings; and that orange trees could be raised on that root for *less* than *one-half* the cost of growing them on orange root. Many thousands were worked on that root and sold; but it was finally discovered that trees on that root soon became diseased, were short lived, and, worse still, that the fruit on such trees partook to a very great extent of the character of the Chinese lemon. Out of twenty-two nurserymen in Southern California, twenty of the number condemned and abandoned the use of the root.

"The subject has been thoroughly investigated, both by interested and disinterested parties, and so far as we have been able to learn, the universal verdict of all disinterested parties is decidedly against the Chinese root.

"In the winter of 1878 and spring of 1879 there were sold and planted in Placer county, California, about twelve thousand orange trees, about one-half of which were on Chinese lemon root. So far as we have been able by careful inquiry to learn results, from fifty to seventy-five per cent. of those on Chinese lemon root have died, while of those on orange root, in the same community, and often in the same orchard, only from two to four per cent. have died. Last spring was cold and wet, as is well known, and the soil in that district being underlaid with bedrock, the roots were virtually submerged in mud and water; hence the fatal result to the lemon root, while the orange root was not affected.

"On very warm soil with a loose subsoil, the lemon root will succeed well for a few years, and it may bear fruit one year earlier than an orange root, but under no circumstances will it bear more than one year sooner. It is at best a miserable dwarf of but a few year's duration, and the planter is destined to see, when too late, that he has been duped and most shamefully swindled.

"To verify our statements about the results of trees on orange and Chinese lemon roots in Placer county we would refer the reader to David Lloyd, Penryn; B. R. Wells, Penryn; A. H. Schnabel, Newcastle; D. H. Brown, Newcastle; Mr. Hathaway, P. M., Ophir; Rev. N. R. Peck, Ophir; Dr. J. R. Crandall, Auburn; George D. Aldrich, Lincoln.

"We herewith append a circular voluntarily signed by as good, reliable and practical men as there are in Southern California, hoping that the most skeptical will be satisfied, and that this much-vexed question will be forever settled.

"We are, very respectfully, WILLIAMSON & CO.

"We, the undersigned, citizens, orchardists and nurserymen of Southern California, are fully convinced, after years of experience and observation, that the Chinese lemon as a stock on which to bud the orange is a practical failure; and while trees on that root can be grown very much cheaper than on the orange stock, we would not, with our present knowledge of its character, propagate them to sell to others, nor would we plant them ourselves if they were given to us: J. De Barth Shorb,

San Gabriel, Los Angeles county, President Southern California Horticultural Society; Dr. O. H. Congar, Pasadena, Director Southern California Horticultural Society; Thos. A. Garey, Los Angeles, nurseryman and orchardist; J. R. Toberman, Mayor Los Angeles City; W. H. Workman, Los Angeles, member City Council; J. M. Stewart, Los Angeles, nuseryman and orchardist; S. J. Beck, Los Angeles, President City Council; J. G. McDonald, Los Angeles, member City Council; S. H. Mott, Secretary Southern District Agricultural Society; John G. Downey, Los Angeles, Ex-Governor California; J. Wolfskill, Los Angeles, nurseryman and orchardist; S. Gates, Los Angeles, nurseryman; A. J. Cooper, Los Angeles, nurseryman and orchardist; Fisher, Richardson & Co., Los Angeles, nurserymen; Mrs. H. Shaw, Los Angeles, orchardist; George Dalton, Los Angeles, nurseryman and orchardist; G. D. Compton, Los Angeles, nurseryman, orchardist and banker; P. Davis & Brother, Anaheim, Los Angeles county, nurserymen, orchardists and bankers; R. H. Gilman, Anaheim, nurseryman and orchardist; Wm. N. Hardin, Anaheim, orchardist; Geo. D. Carlton, Riverside, San Bernardino county, nurseryman and orchardist; L. C. Waite, Riverside, nurseryman and orchardist; J. S. Russell, Riverside, orchardist; George Crawford, Riverside, orchardist; S. C. Evans, Riverside, orchardist; James P. Evans, Riverside, orchardist; L. H. Titus, San Gabriel, orchardist, Director Southern District Agricultural Society; Russell Heath, orchardist, President First National Bank, Santa Barbara.

"Los Angeles, October 27th, 1879."

The Los Angeles *Daily Herald* copied from the *Pacific Rural Press* of March 1st the following report of the committee appointed by the Horticultural Society Branch Fair at Riverside. The committee consisted of L. C. Waite, of Riverside, W. R. Olden, of Anaheim, and Dr. O. H. Congar, of Pasadena:

"Four specimens of the Navel orange, grown upon different stocks, were tested. The properties of the citron were strongly impressed upon the fruit of the tree on citron stock. The same was true of the lime stock, with the exception of the thickness of the rind. One specimen, grown on the Chinese lemon root, has a rind five-eighths of an inch in thickness."

From the *Rural Press* of the same issue: "In answer to an inquiry some weeks ago, we stated that the proper stock on which to work the orange was the orange root, and not roots of the lemon family. This is unequivocally the testimony of the latest European authorities to whose writings we have had access, and it is the decision of the great mass of our California propagators."

The editor of the *Press* says if any accumulative evidence be required on this subject, the parties requiring it can visit Los Angeles, as he has done, and they will return satisfied, as he has, that orange budded, except upon orange root, is not worth planting.

The Riverside Fair Committee made the following official report:

"The committee to whom was referred the subject of stock upon which to bud or graft the orange, beg leave to state that the four specimens submitted for their inspection showed marked and distinct characteristics, although of one variety, to wit, Navel. The first tested was the Navel budded on citron stock. We found the citron quality and characteristics to predominate largely in this specimen, it having the citron rind, pulp, flavor and membraneous divisions all unmistakably impressed. The second test, the Navel on lime root, also gave unmistakable evidence of the power of the stock to impress itself strongly upon the orange bud, in point of modifying the orange quality, giving a well-defined, sub-acid flavor, but not to the degree of modification in this respect, or in respect to the physical appearance of rind, size, pulp or membraneous walls, as that upon the citron, which was larger in size and much coarser. The third was a sample from a bud on China lemon root. This, we have to say, approximates more nearly in all its characteristics to that upon the citron root than to that upon the lime, forcing us to the decision that there cannot be any doubt that the fruit grown from an orange bud inserted upon citron, China lemon or lime roots, unmistakably takes on the acid flavor of the natural fruit of the parent stock, to the great detriment of the well-defined orange quality. But while the orange quality is thus sacrificed, the size of the fruit upon these stocks is largely increased."

The *Rural Press* of March 1st, 1879, says, in addition to the extract herein copied from the *Herald:*

"The judgment of the committee referred to was apparently mainly based, as our correspondent notes it, on the internal evidence of the fruit; its flavor, which is apparently affected by the use of outside stocks; and on the thickness of the skin, the thickness being a concomitant of the rank and rapid growth which characterizes the tree from the sappy root of the lemon family. There is also a point in hardiness, which should not be overlooked, namely: the orange root will thrive in a much greater diversity of soil, and under a much greater diversity of climatic conditions, than the lemon.

"It would be better on many accounts if the general opinion of orange growers adverse to China lemon be found incorrect, because it is much cheaper and much more easy to propagate on this stock than on orange seedlings. Trees can be propagated more rapidly, and they attain size more quickly. It does not appear, however, that these points are desirable in the long run."

# CHAPTER XXX.

## Lemon Culture.

The rules for the selection of seed, site for nursery and orchard, transplanting, cultivation, irrigation, and other general rules applicable to orange culture in the preceding chapters, also apply, in a general way, to lemon, lime and citron culture.

Our lemons have been coarse and undesirable until a very recent date, for the reason that nearly all our products have been seedlings, and, consequently, they have been accorded a second place in the market. Now that the budding of select varieties on orange stocks has become general, the product is much improved, and in a few years our lemons will most assuredly exclude the foreign article from the markets of the United States.

### VARIETIES.

A number of varieties are now seeking for public approval, several of them possessing considerable merit. A variety should possess the following points of excellence to suit the market:

First—The tree should be a strong, vigorous grower, with a tendency to form a close, compact top. It should be free from thorns, and should be an early, regular and heavy bearer. The fruit should be symmetrical in shape, of medium size, juicy, with a strong acid, and seedless. The rind should be thin and sweet.

The Lisbon and the Eureka are the most popular varieties now propagated. It is safe to say that nine-tenths of the lemon trees now being planted are of these varieties. The Lisbon is a fine lemon, having an acid claimed to be somewhat stronger than that of the Eureka. It is a good bearer but not an early one as compared with the Eureka. It has more or less seeds,

and a sweet rind. The tree is a good strong grower, but quite thorny. It was introduced into this country from Australia.

The Eureka is an excellent fruit, containing in tree and fruit all the qualities first above mentioned. It is a chance Los Angeles seedling, discovered and introduced in the following manner: I was for many years seeking a lemon that would compete with those imported. Our seedlings were, until a recent date, all coarse, enveloped with a thick and bitter rind, and were of a very indifferent character. During 1877–8 my attention was called to a chance seedling raised by Mr. C. R. Workman. I found in the tree and fruit all that could be desired, and at once secured the stock, and disseminated the new variety under the name of Garey's Eureka.

Mr. L. M. Holt, who was editor of the *Southern California Horticulturist*, said in regard to this lemon:

"T. A. Garey, of Los Angeles, has secured the stock of a choice seedling lemon raised by C. R. Workman, and propagated by himself and Mr. Preston in this city. It has been thoroughly tested, and is pronounced first-class. The tree is thornless, the fruit seedless, juicy and sweet-rind. The original tree is now seven years old, and produced about two thousand lemons the past season. Several budded trees on orange stock, from three to four years from the bud, are fruiting heavily, and the fruit readily commands thirty dollars per thousand in San Francisco, while the ordinary Sicily seedling brings only ten dollars per thousand. Mr. Garey says he had been in search of a good lemon ever since he entered the nursery business, thirteen years ago, and, as he has found what he claims to be *the* lemon, and has bought the stock owned by Messrs. Workman and Preston, he has named the fruit 'Garey's Eureka.'"

## MARKETING.

We have heretofore been in the habit of picking our lemons and sending them to market immediately. This method will not do, unless the market be a distant one, requiring from three to four weeks to reach. All lemons should be picked and spread thinly in a dry place in the shade for three or four weeks before being boxed for transportation. The surplus water in the rind

evaporates during this time, reducing its thickness very materially, and leaving the fruit in prime condition for packing. Those that would otherwise have decayed in the packages can now be left. The sound lemons will remain sound for an indefinite period, and will be in prime condition when they reach the markets.

Lemon culture is yet in its infancy in this State, the number of trees planted being very small as compared with the number of orange trees. There is at present a disposition to plant lemons more extensively. It is my opinion that all who plant lemon orchards in suitable localities, and of well-tested and approved varieties, will reap a golden reward in the near future.

Several acid tests have been made under the auspices of the Southern California Horticultural Society. At these trials the Lisbon has invariably been considered best, and the Eureka second in the list. But the Eureka combines so many excellent qualities in tree and fruit, I unhesitatingly pronounce in its favor. Were I planting a thousand lemon trees for myself, I would plant only the Eureka.

The lemon is more susceptible to frost than the orange, and should be planted on high, dry, deep soil well underdrained. It requires less irrigation than the orange.

Since the foregoing was written the following article by Mr. Charles Coleman, Jr., editor and proprietor of *Semi-Tropic California*, has appeared in his journal:

LEMONS FOR PROFIT.

"This culture is certainly not receiving the attention its importance demands. Because the seedling usually bears an inferior fruit, and is withal a shy bearer, and is not a healthy tree, we should not condemn the lemon industry, but should look about us for a good variety, that is a heavy bearer and at the same time a healthy tree. We believe these qualities are found in the Eureka, and possibly the Lisbon, budded on orange stock. As regards the Eureka, we can speak from actual experience—an experience which has been highly in favor of this variety in every particular. Three years ago a certain nursery of three-year-old orange trees was budded in May to the Eureka lemon

and approved varieties of orange. Under a good, generous cultivation, the buds made two large growths before winter and had fine bushy tops. The winter was frosty and many of the orange buds were killed, while the lemon buds were not materially damaged. Scattering blossoms were found here and there in the following spring, and the trees grew so it was almost impossible to get through the rows to do the fall cultivating. The buds were two years old the next spring, and the orange root five. The trees were completely loaded with blossoms and young fruit. They were removed and set in orchard form, and now, as we learn from the owner of the orchard, they are producing a profitable crop. The bud was three years old last spring and the root six. We believe this is a fair illustration of what can be done with the Eureka lemon, provided the culture be confined to our inland valleys. The bearing capacity of the trees will increase from this time forward until from six hundred to one thousand will be an average yield. The tree is somewhat dwarfish, is not thorny, a hardy, vigorous, healthy grower, and an early and generous bearer. So much for the tree, and now for the fruit.

"You go to our markets and call for the best lemon, and you will invariably receive the Eureka—a small oblong lemon, rich in juice, rind sweet or slightly bitter—for which you will probably pay double the price of any other variety.

"Now these are facts, and not long-spun theories, and our only excuse for stating them is that our people may be aroused to a just appreciation of a proper and profitable lemon culture. But we must not forget that this industry is not intended for all sections. The inland valleys are the proper homes for all branches of citrus culture, while to the coast valleys we give the palm for deciduous fruits.

"It is a fact needing no argument that there is no danger of ever being able to overstock our markets with a first-class lemon, because the area in Southern California best suited to this growth is limited."

# CHAPTER XXXI.

## Limes.

There are three varieties of limes, namely: Mexican, Tahiti and Sweet. The Tahiti grown with us is worthless. The Swee lime is a favorite with our native population, but it is of little importance as an article of commerce. The Mexican lime reproduces itself from seed in every instance. It is an excellent fruit, some preferring it to the lemon. It fruits at from three to four years from the seed, is very prolific, stands drouth well, and forms a dwarfish, shrubby tree. It is more tender than any other variety of the genus citrus, and, for this reason, its culture has been practically abandoned, except in some favored localities. It is used for hedges where frosts do not damage it, and when well trained it makes a beautiful border or hedge.

The following letter, written by me some time ago for the Los Angeles *Herald*, is inserted as giving my views, substantially, on the question of profit in lime culture:

"I was particularly interested in an item in this morning's *Herald* on the 'Rotting of Limes,' etc. Your remarks bring to the front in our county a vast latent interest, namely: the production of limes. The lime tree is, as is generally known, an early and abundant bearer, quickly producing a revenue. Many orchardists have planted a portion of their grounds to limes, expecting a return in a short time to help pay expenses until the more important fruit—the orange—commenced to bear. But right upon the threshold of the fruiting of the new trees, the cry is raised of 'no sale at remunerative prices.' There are reasons for this, and which I purpose to discuss.

"First—Our producers have not selected their fruit. They have not sent to market *only* first-class fruit, but have sent in-

stead to the commission merchants of San Francisco a heterogeneous collection of large, small, ripe, green, and, in some instances, half-rotten fruit. This fruit could not, of course, compete with the fine, uniform Mexican or Tahiti limes, and the merchants returned account sales of 'nil.' Hence we must learn to put up our fruit properly, and, if we send a second or third-class article, mark it as such, and not mix it with what is first-class. I will say, in this connection, I have just received from Messrs. Littlefield, Webb & Co., of San Francisco, account sales of my last shipment of limes, returning me net seven dollars and forty-five cents per thousand, and they wrote on the margin, 'Good, well-selected limes looking up.' This tells the story at this season of the year. But what shall we do when vessels laden with this fruit begin to arrive from Mexico and Tahiti? I would say in reply:

"Second—Flood the market at the same time with our own fruit. One or two trials will let out the shippers of foreign limes, and we shall have the markets of this coast all to ourselves.

"Third—After having secured and controlled this market, we must introduce our limes to the lemonade drinkers of the 'States.' Limes are almost unknown in the East, lemons being used almost exclusively there. Introduce limes, and the convenience alone of using them, as compared with lemons, will give the market to the former.

"Fourth—In addition to the foregoing, a citric-acid manufactory, as you suggest, to work up the unmerchantable fruit, would cause lime culture to return thousands of dollars a few years hence to enrich our people. It may be asked at what price can we lay the fruit down in San Francisco at a profit to the grower?

"I feel confident that the lime growers of this country will be quite satisfied with a prompt market at twenty-five cents per hundred, or two dollars and fifty cents per thousand. Lime trees at twelve to fifteen years old bear from two thousand to five thousand limes annually. One hundred and nine may be planted to advantage on an acre. I leave the calculation on income per acre to those having an interest in this industry."

# CHAPTER XXXII.

## Citrons.

The preserved citron peel of commerce is manufactured, as its name implies, from the rind of the fruit of the citron tree.

The tree grows to perfection in this State in localities in which there are no heavy frosts. It is a good bearer, and the fruit is very large, some specimens weighing as much as four pounds and having a diameter of some four inches, but with a small pulp, three-fourths of the fruit being rind.

Many futile attempts have been made to preserve the peel, the difficulty having been in the extraction of the bitter properties from the rind. A firm in San Francisco have recently succeeded, however, in preparing a first-class article, and have advertised for all the citrons that can be produced, and at remunerative figures.

It is propagated from cuttings, which grow readily and thriftily, producing fruit in two or three years. The tree is but a shrub, as compared with the orange or lemon. It has a dwarfish, ungainly habit of growth.

Los Angeles *Commercial:* "For many years our orchardists have cultivated the citron, with the desire and belief that some individual or firm would be found capable of utilizing them for commercial purposes. But many seasons passed without any encouraging demand. The growers became discouraged and gradually neglected their trees; some, indeed, unfortunately uprooted them. We are now about to hold forth the olive branch of promise, and a happy moment it is for us. We are authorized to state that a San Francisco firm, Messrs. James, Parisen & Co., have succeeded in preparing California citron, orange and lemon peel in so satisfactory a manner as to compare favorably

with the best imported; and no better guaranty can be given than the fact that Messrs. Wm. T. Coleman & Co. have accepted the exclusive agency for the goods of this firm. Now, our advice to orchardists is, plant citron, China lemon, bitter and Seville oranges, as this firm will purchase, at fair prices, all that can be produced. This is certainly a bright outlook—a good market for products so easily raised, and which have hitherto proved so utterly unprofitable."

# CHAPTER XXXIII.

## Orange Wine and Brandy.

The profitable disposition of our surplus fruit is of importance. It will undoubtedly be many years before we shall have a surplus of good fruit; but so long as there shall be seedling orchards, and also so long as proprietors of budded orchards neglect to thin out their fruit annually and properly, so long there will be more or less inferior fruit, and for which there should be found some method of profitable disposal.

The subject of orange wine and brandy has been agitated for a number of years. It is thought it will yet provide a way for the utilizing of our surplus oranges, and those that may be so inferior as not to be salable for edible purposes. No experiments have yet been made here in the manufacture of wine or brandy from oranges.

The following is appended for the information of those who may feel inclined to investigate this subject:

"Orange wines have made their appearance in the markets of Valencia, Spain. There are four kinds: Imperial and Dry, made in January; Mandarin, made in April; and Mousseaux. The wine is of an agreeable color, perfectly clear, and of a sweet taste relieved with slight acidity. It contains about fifteen per cent. of alcohol. It is thought that if the phylloxera continues its ravages this wine will play an important part in Spanish commerce."

"The orange growers of Florida are turning their attention to the making of wine from oranges, and several experiments have indicated a possibility of success in this direction. The first wine made from oranges in Spain has lately made its appearance in Madrid."

## EXPERIMENTS WITH ORANGE WINE.

"The constantly extending ravages of the phylloxera have induced the inhabitants of certain wine-growing countries to consider from what fruit a product may be obtained that will most resemble the juice of the grape in appearance, taste and bouquet. Experiments have been made and the fact has been established that the liquid extracted from the orange would constitute a resource on which to fall back. The first trial made showed that when the oranges have attained their full development they are unfit for this purpose; and that they must be selected, not when fully mature and superabounding in sugary principle, but before they are fully ripe, and while they still possess an appreciable amount of citric and malic acids.

"The experiments hitherto made are still too limited, and the methods of fabrication too rudimentary, to justify placing the article on the market.

"This very important question arises: If ever success be obtained in its production, can a sufficient quantity of the fruit be secured to replace the grape, and if so, what will be the relative cost of wine from the vine and the orange?

"If attention be turned in this direction, we shall doubtless be provided with some sort of liquor, probably of excellent quality; but we very much doubt that the orange or any other fruit can compete with the grape."—*Town and Country Journal.*

The following, by Mr. Edward Preuss, is from the *Semi-Tropic California:*

"I was for six years a resident of the State of Florida, and there and in the adjoining Southern States followed the occupation of wine-making for five years. All my wines, still and effervescing, which I made from the *vitis sulpina* or *vitis rotundifolia* varieties, were acknowledged by connoisseurs to be of excellent quality. Encouraged by my success as a wine maker, I tried to make wine from the sour and bitter-sweet oranges which are indigenous to Florida, and my labors were crowned with success. The first orange wine which I made from sour oranges at Sanderson, Bakers county, Florida, was sold at Jacksonville, Florida, for three dollars per gallon, and the wine was then only eight months old, and will probably

command double the value by this time, as the orange wine cannot be surpassed by any other wine for medicinal purposes.

"There are a great number of orange groves in Southern California; the yield of all the trees of the citrus family is very great. The demand for oranges along the Pacific coast is far below the production, and the exportation of oranges to the East will never be a lucrative business for California, on account of the great distance by rail, as all the Eastern States can procure their oranges at a lesser cost from Florida and Louisiana. But we have to utilize our surplus oranges, and can do so only by making wine from them; this would diminish the bulk and greatly reduce the cost of transportation to any part of the country.

"I will give to our orange growers a few directions, founded upon my own personal experience, how to make wine from oranges:

"The oranges must be perfectly ripe, else the saccharine matter they contain will not be entirely developed. The oranges are peeled first, then cut into halves, across and not lengthwise of the cells. The cutting must be done over a tub, so as not to lose any juice; both halves are pressed hard by the cutter. A good workman can peel and squeeze one hundred and twenty oranges in one minute. When the tub is full of juice and oranges, the whole mass is carried to a press, which must be so close that none of the seeds can escape into the must, as the seeds would give the wine a bitter taste. I added two pounds of the best white sugar to each gallon of juice of sour oranges, one and one-half pounds to the juice of bitter-sweets, and one pound to the juice of sweet oranges; and to each gallon of the mixed juice one quart of pure water. The whole is put into a barrel, and a space of about five gallons capacity is left for the expansion of the wine during fermentation.

"Orange wine has to undergo the lower fermentation, as by the upper fermentation all the volatile matter and the aroma would escape. The barrel must be closed air-tight, and a fermenting tube adjusted. The fermentation is very vigorous for the first few days, and the barrels must be closely watched to prevent their bursting. The fermentation subsides gradually

after a few days; then the wine has to be racked off, and the lees can be filtered. The fermenting tube has to be adjusted again to the new barrel, and must remain until the fermentation shall have ceased entirely. The wine has to be racked off a second time about six weeks after that period; it will be fit for market in a month from this time, as no second or 'spring' fermentation occurs, as is the case with grape wines.

"Orange wine is of an amber color, tastes like dry Hock, but forever retains the aroma of the orange.

"From the cakes I took out of the press I made vinegar by adding water and molasses; it was sold at twenty-five cents per gallon, wholesale. Oil of oranges or an extract of orange can be made from the peel, so every particle of this delicious fruit can be utilized. Twelve hundred sour oranges and fifteen hundred bitter-sweet or sweet oranges make forty-five gallons of wine and ten gallons of vinegar."

# CHAPTER XXXIV.

## Rules for Ascertaining the Number of Trees or Plants that can be set on an Acre.

First—When they are set in the common order, that is, in the form of squares or rectangles.

RULE.—*Multiply the distance in feet the rows are apart by the distance apart in the row, and divide 43,560—the number of square feet in an acre—by the product.*

Example: How many trees, 20 feet apart each way, can be set on an acre?

Solution: 20 multiplied by 20 equals 400, or the number of square feet each tree will occupy; 43,560 divided by 400 equals 108.9, or the number of trees.

Second—When set in the quincunx order, as in the diagram:

B C
E
A D

RULE.—*Multiply the distance apart in feet in the row (from A to B) by the distance apart diagonally (from A to E); multiply the product so obtained by .866, and divide 43,560 by the product last obtained.*

Example: How many trees, 20 feet apart each way, can be set in the quincunx order on an acre?

Solution: 20 multiplied by 20 and the product multiplied by .866 equals 346.4, or the number of square feet each tree will occupy; 43,560 divided by 346.4 equals nearly 123, or the number of trees.

*Note 1.*—Half the distance from A to D may be found by multiplying the distance from A to E by .866.

*Note 2.*—The tree at E should be in the center of the rectangle formed by those at A, B, C and D.

# CHAPTER XXXV.

## Recipes.

### LEMONS.

Lemons a Cure for Consumption.—A correspondent of an English medical journal furnishes the following recipe as a new cure for consumption:

"Put a dozen whole lemons into cold water, and boil them until soft, but not too soft. Roll and squeeze until all the juice be extracted. Sweeten the juice enough to make it palatable and then drink it. Use as many as a dozen per day. If they cause pain or looseness of the bowels, lessen the number and use only five or six per day till better. By the time you shall have used five or six dozens you will have an appetite and begin to gain strength. You need not use so many, of course, as you improve. Follow these directions and we know you will not regret it, if there be any help for you. We know of two cases, both of which were in the last stages of consumption. Both were given up by the physicians, yet they were cured by using lemons as stated. One lady in particular was bed-ridden, and very low. She had tried almost everything money could procure, but in vain. To please a friend, she was finally persuaded to use the lemons. She began to use them in February, and in April she weighed one hundred and forty pounds. She is to-day a well woman, and likely to live as long as any of us."

### LEMON CATSUP.

"One pound and a quarter of salt, one-quarter of a pound of ground mustard, one ounce each of mace, nutmeg, cayenne and allspice, one gallon of cider vinegar, eight or nine garlic cloves,

fifteen large lemons. Slice the lemons; add the other ingredients; simmer from twenty to thirty minutes; place in a covered jar; stir every day for seven or eight weeks; strain, bottle, cork and seal."

LEMON PUFFS.

"Beat and sift a pound and a quarter of loaf sugar and mix with it the grated peel of two lemons; whisk the whites of two eggs to a firm froth, add it gradually to the sugar and lemon, and beat all together for one hour. Make it up into any shape you please, place the puffs on oiled paper or tin, put them into a moderate oven and bake for six or eight minutes."

LEMONS TO PICKLE.

"Take the finest, with the thinnest rind you can get, cut them deeply in more than one place from end to end, but not quite through, and fill the incisions with salt; put each on end, and lay them all in a dish near the fire, or, if the weather be hot, in the sun, and repeat this during three weeks; then put them into a jar, with a handful of white mustard seed, if the jar be large; a quarter to a half-pound of bruised ginger, half that quantity of cloves and allspice and a very little turmeric; boil it in vinegar, and when cold pour it upon the lemons. Some add garlic to it. It can scarcely be ready in less than six months, but it will keep for many years. The same method must be pursued for limes or small lemons, but they will not require more than half the time."

LEMON PIE.

"Add one teacup of sugar and one tablespoonful of cornstarch, dissolved in cold water, for each peeled and grated lemon. Pour a teacup of boiling water over this. Crust—One part each of white flour, graham flour and cornmeal. Shorten with butter or condensed milk, reduced one-third. Use two crusts."

VELVET CREAM.

"One ounce isinglass, a teaspoonful of wine, the juice of a large lemon, one pint of rich cream. Dissolve the isinglass in the wine; rub large lumps of sugar over the lemon to extract the oil; squeeze out the juice and sweeten to taste. Boil this

mixture and strain it; when quite cool, add the cream and put it into molds."

LEMON CUSTARD PIES.

"One and a half cupfuls of white sugar, one and a half tablespoonfuls of flour, one heaped teaspoonful of butter; stir them all together, then grate in one good-sized lemon and add three cupfuls of boiling water—stirring it all the time. Beat four eggs, the whites and yelks separately; add the yelks first, then the whites. This will be enough for three pies."

LEMON CAKE.

"A delicious lemon cake which will keep well, and which is better, in fact, after having been kept a week, is an easily-obtained luxury. Take two cups of sugar, half a cup of butter, one cup of milk, three eggs, two and one-half teaspoonfuls of baking powder, and three cups of flour. This makes five layers. For the jelly use the juice and the grated rind of two large lemons, one cup of sugar, half a cup of water, one teaspoonful of butter, one tablespoonful of flour mixed with a little water; boil until it thickens, then place it between the layers of cake."

ORANGES.

"Orange Pie.—Rub a teaspoonful of powdered sugar and a tablespoonful of butter to a cream, mix a tablespoonful of cornstarch with a little cold water and a teacupful of boiling water; let it cook long enough to thicken, stirring constantly, then pour the mixture on the butter and sugar. Grate the peel of half an orange and chop the other half fine, first removing all the inner white skin. Add this to the former ingredients, also a beaten egg and the juice of an orange. Peel another orange and slice it in little thin bits, being careful to remove all the seeds and the tough white skin. Line a pie plate with a nice paste, and bake it until just done, then fill with the custard and orange slices, and bake long enough to cook the egg. A meringue made of the whites of two eggs, a pinch of salt and two tablespoons of powdered sugar, beaten to a stiff froth, will be an improvement. Spread it over the pie; sift powdered sugar on the top, and set again in the oven, leaving it till slightly colored."

ORANGE SNOW.

"The juice of four large oranges and one lemon; the grated rind of an orange and half a lemon. Soak a package of gelatine in a coffee cup of cold water. When dissolved, add the juice and grated rind and a coffee cup of white sugar. Cover and let stand an hour, then pour on two and a half coffee cups of boiling water; strain through flannel; when cold, whip in the beaten whites of three eggs; turn into a mold and set on ice."

ORANGES FILLED WITH JELLY.

"Select large oranges, and with a sharp penknife remove from the top of each a round piece the size of a quarter; then, with the handle of a teaspoon take out the pulp, being careful not to break the rinds, which should be put into cold water. To make the jelly, use gelatine and the juice pressed from the pulp, straining the juice, that it may be quite clear in color—one-half of the jelly a bright rose color, with currant jelly, wine or a small quantity of prepared cochineal. When the jelly has cooled somewhat, strain it, wipe the oranges, and fill them with alternate stripes of two differently colored jellies. Each color must be allowed to set before pouring the other in. When the oranges shall have become perfectly cold, quarter them with a very sharp knife, and arrange tastefully in a glass with sprigs of myrtle among them."

ORANGE MARMALADE.

"We find in an English exchange an outline of the method by which a well-known house of preserve makers make orange marmalade for shipment to all parts of the world: Marmalade is manufactured during the months of January and February, when the Seville oranges are in season. The cutting and pressing of the oranges takes place in these months, and we had the good fortune to be just in time to witness the marmalade industry in full operation. The marmalade is made in a large building erected especially for the purpose. On entering the large apartment on the ground floor we found a fragrant perfume of oranges permeating the place—a perfume savoring distinctly of marmalade. Seville 'sours' are imported by shiploads for this business, the oranges being carefully selected, each being

wrapped in paper when deposited in the chests in which they are packed. Hundreds of women are engaged throughout this busy season cutting the oranges into quarters and stripping the peel, this work being done with surprising celerity. Steam machinery cuts the peel into thin shreds, which issue from the cutter in myriads of slices, marvelously fine, with a refreshing bouquet. The pulp, or interior portion of the orange, is scalded and passed through a sieve, also worked by steam power. The pips and particles of skin alone are rejected. This machinery is admirable, and the mode by which the useless portions—fine and small as are the pips and skin—are separated from the pulp, testifies to the perfection to which modern appliances have been brought by inventive genius. The peel and pulp are then mixed and removed to the boiling room. We ascend from the ground floor to the boiling room, which is in the upper story. This light, spacious and convenient apartment contains forty copper pans, shining like burnished gold, and each capable of boiling one and one-half hundred weights of marmalade or jam. The stirring is done by machinery, a complete mechanical arrangement for this operation being driven by a small and handsome new engine. On the floor beneath the marmalade is put into pots by females, who fill the vessels as fast as they are brought to them, from a trough or receiver containing the preserve. The pots and jars are then stacked away on trays until cold, when they are covered, tied over, labeled and packed."

# APPENDIX.

SAN GABRIEL, Cal., December 26th, 1881.

MR. THOS. A. GAREY.

DEAR SIR: I am in receipt of yours, and regret exceedingly that press of business prevents my revising or writing at all for your book. If the letters heretofore published in the *Semi-Tropic* or *Herald* are of any use to you, you are more than welcome to use them.

Regretting that I cannot do more for the present, with kindest wishes for the success of your work,

I am respectfully yours, L. J. ROSE.

[The above letter explains itself, and in pursuance of the kind permission of Mr. Rose, the subjoined extracts from his letters to the press on grape culture are given (as an appendix to my book) substantially as written by him. They are of great value, coming as they do from a man of great practical experience in the matter of viticulture in this State. They give in a concise manner a full text of the main and principal features of the business, and if followed to the letter will, I confidently believe, give full satisfaction.—THOS. A. GAREY.]

## INTRODUCTORY.

SUNNY SLOPE, March, 1880.—Sunday morning, after the rain, again all is lovely. The rain has made a good season almost assured, and all is brightness and contentment. Even the air is washed out clear and pure. The land is covered in every part by the tender green of the new-growing grass; flowers have their faces washed, and the rose, jasmine, heliotrope and geranium have a fresher and brighter look, and with a fresh fragrance perfume the air. Even the birds are animated by a new life, and flit in and out among the branches of the pepper trees, almost bursting their throats with their spring melodies. The sun shines brightly, the air is soft and balmy, and not a breath of wind is stirring; the bee hums lazily in the casement; the eagle soars slowly over Sierra Madre Villa; and even rest-

less man partakes of the quiet and contentment all around him and stops, while the smoke of his pipe makes ascending circles in the air, and feels that it is pleasant to be, and that this is a good land to live in. The higher peaks of the mountains, like San Gorgonio, in the San Jacinto range, ninety miles away, and "Baldy," nearer by, have their winter caps of snow, giving us winter pleasantly distant, while here the orange tree is loaded with its golden fruit, and the kitchen garden is in full growth. Here it is spring; there it is winter. Little do we realize the many advantages and blessings we are enjoying. The farmer here has all winter to plant, and all summer to reap, enabling him to accomplish twice the work and twice the production that he could anywhere outside of the Pacific coast, and that with the least possible amount of sickness. Here every day brings with it to him renewed life and health.

These are facts that are nothing new to any one of us. We all know them if we but stop to think. Many of us may be hard pressed for money; we may have been too sanguine, and gone too fast; we may be in present difficulties; but, if the past lessons are heeded, a bright future is all before us, and that the future of our county is very bright is to me a certainty. Never has the immediate prospect for the southern counties been so full of promise. The "boom" seems to be here. In a year we will probably have a new railroad; certainly railroad connections. Already we are beginning to feel the trade that is coming to us from Arizona, and each mile of the new road increases it. Arizona, New Mexico and Colorado are countries of limited agricultural resources, but a large population, by reason of their mines, will be consumers. Southern California is great in agricultural resources, and it is the nearest place for them to get their supplies. The railroad company have given us a favorable tariff of freights. In the near future our harbor will be improved, so that it will be sufficient for all our wants. We will have rail and ship connection, and do away with lighterage, in all of which the railroad company have kindly promised to aid us. Then we will have direct shipping to all countries. We will be on the free highway of the world's commerce. We will have all that a country can have. With these advantages, with a most fertile soil and a climate unsurpassed in the world, what is to prevent us from being the richest and the happiest people on the globe?

But I am reminded that you wished me to write about the grape, and that I am spinning out these pleasing prospects and self-evident facts too long. I turn with pleasure to that subject, not that I believe I will say much that is new. Many of my confreres who may read this may smile at the many details as being an old story to them, yet a few may find something to

think about, and to the beginner it will be some guide by which he can profit; for if he follows the directions given, he will have some assurance that this same mode has raised vineyards. We have thousands of acres of land which will raise grapes in paying quantities without irrigation, and make pleasant and happy homes, where are now wastes covered by chaparral, sagebrush, cactus, etc; and I believe that these very lands, that are now supposed to be of no value, are especially adapted for the grape, and that, too, without irrigation. I have cleared and planted such a piece of land, and up to this date I have never seen a vineyard that made such growth or produced so well, and without irrigation while planting or since. Most of this vineyard is only one and two years old, yet I have a small corner of such land which is fifteen years old, and these vines have borne more, are larger and of a thriftier growth than other vines adjoining on apparently richer land—land that grew good grass, while the sandy, or almost sand, grew nothing but brush and elder bushes, with now and then a sycamore tree.

### EXPOSURE OF A VINEYARD.

In this land of perpetual sunshine a level piece of land is preferable; and if a hillside, a northern exposure is preferable to a southern. A level piece of land will absorb nearly all the water that falls as rain, while a slope will shed it. Where irrigation is practiced, water will wash all the finer particles of soil—the valuable portions—away, whereas, the nearer a level, the more easily it will be flooded. Nearly all beginners in planting in this are almost sure to make a mistake, for they have learned that the finest vineyards of Europe and the East are grown on hillsides and southern exposures, but they do not remember that in this country the conditions of rain and sunshine are entirely changed. Here we have a lack of water, but an abundant supply of warmth. There a good season consists in a dry and warm summer; here in a wet season. A hillside is a necessity there, for it sheds the rains and sooner drains its water, which is taken up by the soil during the rain, and every favorable condition to get all the warmth the sunshine can furnish has to be taken advantage of; whilst here, if grapes are not ripe in September they can hang on the vine until December.

### WHAT KIND OF SOIL IS THE MOST SUITABLE.

Life has as yet been too short to speak about this subject with certainty, and in a century from now opinions will still have to be modified. My experience is confined to my immediate neighborhood, and even in this limited space there have been trials only to a limited extent, for a soil that will suit one grape may be entirely unfit for another. There are, however, some general

facts that are safe to accept. A finely divided sandy soil will absorb water readily and is easily worked. It will, too, retain water in summer much better than adobe or clay, or a coarse, porous soil. Adobe and clay soils are good for the raising of such crops as grow in the winter, like grasses, wheat, barley and oats; sandy soils, on the other hand, are adapted for summer-growing products, like corn, melons, pumpkins, fruit trees, grape vines, and not suited to grasses. The first, in summer, with heat shrinks and cracks. It is in a favorable condition to evaporate its water easily, for a solid, hard earth will sooner lose its water than a soft, mellow surface, as can be seen by our roads, which always dry up sooner than the land on either side. The condition of its capillary attraction, by the spaces between the particles of its soil being close together, are favorable for drawing the water in warm weather out of its soil; whereas a sandy soil, by its porosity, has less capillary power to draw the water to the surface and more capacity to take up air in daytime, which, by the cold at night is condensed into water, when more air is again taken up to go through the same changes. Man can do much to assist in retaining water in a soil by cultivation—stirring the soil. Even a very light soil will, by rains, dew, gravitation and other forces of nature, continually form a crust on top, harden, presenting favorable conditions for shedding rain and also for evaporation. By plowing, this is counteracted, and the oftener this is done the more moisture will be retained and added by giving free ingress to the air and cutting off evaporation; for a loose soil, if only a few inches on top, acts as a mulch. It cuts off communication with the lower strata of soil; it acts like a lamp that has its wick severed above the oil; it stops capillary connection with that below. Such a soil can be easily kept in such condition by cultivating, say once a month, with a minimum of labor; but an adobe or clay soil is very difficult to work; it breaks up in clods, giving more surface for wind and sun to act upon and dry; and, if broken up by beating the clods, makes an almost endless task, for the first rain to pack together again. Cultivation should be continued during the entire summer. The ground may be entirely without moisture on the surface; it may be dry to such a depth that weeds do not sprout any more, and every object apparently wanting for stirring the ground, yet you will find that your grape vines will show by their renewed vigor and growth after cultivation that it has not been labor lost. Of course this continued cultivation is only possible in vineyards the first and second years of their growth. When older, they early in the season cover the ground so that no horse can get through them, and by shading the ground, they prevent much of the evaporation and stop weed growth;

but, even with old vines, cultivation should be kept up as long as possible.

Cultivation should, too, be thorough and continued as long as any weeds make their appearance, for all growth is at the expense of water. Grass or weeds, while making an earlier growth, take up the water in your soil by their roots and evaporate it by their leaves more rapidly than your vines, for they run through to their maturity earlier, and many of them evaporate and use more water. At any rate, whatever you allow them to appropriate from your soil is lost to the grape.

The method of cultivation consists in plowing with a single horse, beginning in the center between two rows of cuttings with a back-furrow, and going backwards and forwards until all the land is plowed up to the cuttings. This requires a careful hand, or else many of the cuttings will be destroyed. If your land is sandy and works easily, and free from clods, this will be all the plowing that will be necessary, and all after-stirring of the soil can be done with a cultivator, each time going the cross way from the time previous. This will level your ground, and by following it up once a month until July, and again, say in the middle of August, will keep the cuttings growing vigorously, keep your ground moist with even ten inches of rainfall during the winter (and irrigation would be of no benefit), and keep your ground free of weeds and looking like a garden. The kind of cultivation is of but little importance; the most simple, durable and cheapest will be the best, for your ground will be in easy condition for working. Stirring the soil in this way, breaking the crust which forms (a condition favorable for evaporation), destroying the weeds while they are small, and keeping the land level are the things you wish to accomplish.

### WILL IT PAY TO RAISE ROOTED VINES?

This depends upon various conditions. If it is found that the season is a very dry one, then planting cuttings in vineyard form will be attended by much loss, a large percentage not growing without irrigation, whereas, if in nursery, they can be better cared for and watered, even by hauling water from a distance. Again, if rooted vines be planted, even in a very dry season, they will start and grow if such cultivation is practiced as here described. Again, parties not being fully ready with their land to plant this year, could root their vines in nursery and be ready for next year, for any season that might come, and gain, say six months in growth, for a rooted vine will make a larger growth than a cutting, although it will not be equal in size to the vine planted in place at once of the same age.

### HOW TO PLANT THE CUTTINGS.

This is usually done by making a hole with a crowbar the

depth desired to plant, say from twelve to fifteen inches, and a man following and placing the cuttings. Many persons plant much deeper, but I think it is a mistaken idea. Their theory is the deeper, the more moisture; but I think it will be found that when your soil is dry twelve inches, it is dry altogether, and with proper cultivation it will not be dry, no matter how little water you may have had. The most natural way for a cutting to throw out roots is at the bottom, especially if it has been cut smooth just below a bud. To enable it to throw out roots, however, at the bottom, it must not be planted so deep as to be out of the influence of air and warmth. This is why twelve or fifteen inches is better than a greater depth.

If you are planting without irrigation, then much the best way is to pour a quart of water in each hole, and have some one follow with a crowbar and immediately close the hole, which is done by forcing the bar down about three inches from the cutting to the full depth of the hole containing it, and working the bar backwards and forwards in the direction of the cutting. In this way the ground is pressed around the cuttings the whole length of that portion which is under ground. Upon careful attention to this apparently trifling matter the growth of your cuttings depends, for if the holes are filled or closed at the top only, the bottom of the cutting will become mildewed and decay.

If planting is done by irrigating while planting, making the water do the filling of the holes, so much the better, although the first way is good enough if care is exercised; and even when irrigating it is much safer to have a man follow with the crowbar and probe around each cutting as the water runs, and make sure that each hole is filled with earth.

### HOW TO TAKE CARE OF GRAPE CUTTINGS BEFORE PLANTING.

The best way, whether grape cuttings are to be planted as soon as received or to be kept some time, is to submerge them entirely in water and keep them there for twenty-four hours at least, and as much longer as it is desired to keep them; even if kept submerged for two months it will do no harm, and probably be a benefit. The next best way to keep them is to bury them entirely, or four-fifths their entire length. Care should be taken not to place them in large masses without earth between them, for in that case, those cuttings which have no earth in contact with them will mold, and this mold is the forerunner of decay and death. When to be kept for any length of time, then it would be best to place them in such a manner that earth will come in contact with every part of the cutting which is underground. Then, again, care should be taken to see that the earth is wet and kept so, for if it is as dry or dryer than the cutting, it will absorb the moisture from the cutting until the

point of saturation is equal, whereas if it is kept wet it will give up moisture to the cuttings, and keep them in favorable condition for growing.

## PREPARING GROUND FOR PLANTING.

The study has ever been with me, how to do a piece of work well enough for success with the smallest expenditure of labor. I break up my ground, say four weeks before planting, using a strong pair of horses for an ordinary double plow, and plow as deep as I can with such a rig. In four weeks, or just before planting, I run the harrow over it and make it as smooth as it can be made. Waiting four weeks gives time for weeds to come up, which are easily destroyed by the harrowing. The ground now being ready for planting, it is laid out into squares. We will say a forty-acre tract is to be planted. First, I would lay out a main avenue through the center, and would make it forty-eight feet wide—or even sixty feet would be no objection—then have a road twenty-four feet wide all around the outside. This will give two pieces of equal size lying on each side of the avenue, and bounded by a twenty-four foot road on the other three sides. These two squares should be divided into four equal spaces, extending from the avenue at right angles, and being about twice as long as wide, with roads of eighteen feet width.

Each of the oblong spaces would be about one hundred yards wide and two hundred yards long. Now the first base line is ready for planting, beginning at the edge of the avenue and twenty-four feet inside the end line, running parallel with the twenty-four-foot road across the end to within twenty-four feet of the side line or road.

Then the next base line is begun on the avenue one hundred yards below the first line, again beginning at the avenue and running exactly parallel with the first planting.

This gives two base lines enclosing one hundred by say two hundred and four yards. Now to fill this in is an easy matter, provided you are prepared with a line or chain made of the smallest sized telegraph wire, the links being six feet long exactly, and containing fifty links with a ring at each end, two feet from the end of the link. Stretching the chain from vine No. 1 in base line No. 1, to vine No. 1 in base line No. 2, will bring the end of each link in the chain even with cuttings No. 1 in both base lines, and every other link in your chain will show you where to plant a cutting, and your base lines being made with exactness, all your other work will come out exact, and the rows of your vineyard will all be straight as an arrow in every direction.

### WHAT DISTANCE APART SHOULD VINES BE PLANTED?

I believe six feet each way is better than a greater distance for *wine*. France and Germany plant much closer, and it is contended that a less distance will produce more sugar to the acre and make better wine. There all labor is performed with spade, hoe and hand; here all labor should be performed by the plow, cultivator and horse; there labor is cheap; here it is high. Six feet apart each way gives plenty of room to perform this labor by horse power. To plant wider apart will produce larger grapes and larger bunches, and for raisins, where this is desirable, it may be proper. It, too, gives space to dry raisins among the vines; but for wine small grapes are preferred, and per acre there will be a larger yield six by six than eight by eight feet, although to the vine there will be more the greater the distance apart they are planted. Having planted one square, the planting of the others will only be a repetition of the first, and will be easy sailing.

After having planted the cuttings, I cut them all back, say to six inches above the ground; for the less above ground the more readily will they grow, there being less evaporation from the cutting.

### IS IRRIGATION A BENEFIT TO YOUNG VINES?

In ordinary seasons of rainfall, I think not; and it entails much work and expense for irrigation—for irrigation brings weeds, and each irrigation should be followed by plowing. Young vines require no water, for the evaporation from their leaves, there being but few leaves, as the plant is small, is but little; whereas they have six feet square of ground for their reservoir to draw from, and that quantity of soil contains enough water, if the water is retained by cultivation, and foreign vegetation, as weeds, prevented from absorbing it, to nourish and maintain the vine in full vigor and largest growth. Irrigation will be beneficial when vines are in full bearing and growth, in keeping them in vigor and health, and in producing each year large crops, although grape vines will flourish and bear for a term of years without irrigation.

### CAN GRAPES BE GROWN WITHOUT IRRIGATION?

This can be answered with certainty, yes. Some soils are more favorable than others, but every soil that with rain will grow anything, will grow the grape vines without irrigation and produce grapes. In observing different plants which grow, we find a great difference in the quantity of water required by different varieties or species of vegetable life. Though a product be almost entirely composed of water is no evidence that such fruit or plant requires much water. For instance, many kinds

of cacti will only grow where the soil is almost devoid of moisture, with much heat, as can be seen on the deserts of Arizona and Mexico, yet the cactus is almost entirely water. The watermelon does much better and is much richer in saccharine matter where grown with little water. On the other hand, the rush, which only grows in swamps, is almost devoid, even while it is growing in water, of moisture, and is used by the cooper for the joints in his barrels, to make them water-tight. Again, all will have observed that in our dry plains, after the grasses are withered and dead, and the soil is apparently dry, a new order of vegetation springs up, grows, blooms, forms seeds and dies. From this we see that different plants have different natures in regard to their water wants. The grape is one of those plants that does not require the excess of water, or, rather, it can exist and grow with a small water supply, and can be cultivated profitably for a time; how long will depend on the kind of soil, and whether a soil is rich in such plant food as the grape requires. I have a vineyard of twenty acres which is on a side hill, southern exposure, and very gravelly, dry soil. There is no locality on all of my lands drier and sooner dried out. It formerly, when in a wild state, grew sparingly pin grass of a very stunted growth. All this land is above my irrigating ditch, so that even if I had a desire to irrigate it, it would be impossible to do so. This vineyard is now about ten years old, and since the second year has produced a fair crop of grapes; and even two years ago, when we had only three inches of rain, it yet produced more than a half crop for that land. This hillside is planted in the Blaue Elba, Zinfandel and Berger varieties of grape. Now I cannot conceive of a more severe test, and it is worth all the theorizing that could be done in a month. Many persons say to me that for young vines, especially for the first year, water is necessary. Now, the reverse is true. When once a grape cutting begins to put forth its leaves, when roots have formed and both proceed simultaneously, then a very small quantity of water is necessary to maintain its growth. The root of the vine elongates very rapidly, and if water were scarce at twelve inches in depth, it would soon reach out twenty-four inches more, if the water were there for its wants. Plants require water in proportion to their size and the amount of fruit (seed) to mature; or, rather, more exactly, in proportion to the size and quantity of their leaves, for these are their surfaces to gather plant food in the form of gases from the atmosphere and to evaporate water. All this water which is evaporated in warm days is brought into the leaves from the soil by its roots. It is easily understood from this that a plant that has many leaves has much surface for evaporation. A small plant, therefore, requires a little water; a large one in proportion to its size; whereas, in a vineyard a

small vine occupies the same space (six feet square) as a larger one, and the soil can only give up what it has received, and has been kept there by keeping the soil in a favorable condition to retain its water, namely, cultivation. Agricultural chemistry is becoming a more important science every day, and many scientists are now devoting their lives to its study, and much benefit is now derived from them by the "book farmer."

By reading the results of the experiments as to how plants grow and feed, by such men as S. W. Johnson, Professor of Agricultural Chemistry of Yale College, but mostly by the Germans, who have many experimental stations for the employment of many chemists engaged in theoretical investigations of manures, the analysis of soils, and how to grow various plants and crops, it is found that plants receive from ninety-five to ninety-nine per cent. of all their food from the atmosphere, and, consequently, only from one to five per cent. from the soil; that the conditions of the atmosphere are substantially the same all over the world, and cannot be changed. For this reason man has no control over that part, but only what is received from the soil. The soil furnishes, although so small a part, yet such indispensable ingredients as water, potash, lime, magnesia, phosphoric acid, sulphuric acid and some other acids, but these may be considered the essentials.

Plants have no power (certainly not in any beneficial quantity) to inhale water, or to take up water, in any other way than by their roots. Roots have the power to absorb water, not only by their ends (spongeoles), but their entire surface, and the inorganic ash ingredients of the plants are taken up by the water in solution; and, in combination with gases of the atmosphere, mostly carbonic acid, making organic structures of the plants. If water is supplied in insufficient quantity, the plant will languish, make small growth, produce a short crop, although the product of seed (grape in the vine) will be large in proportion to the growth. If water is too abundant, there will be much growth of wood and a comparatively small crop of seed. This brings us to the subject,

## IS IRRIGATION BENEFICIAL?

Which must be answered in the affirmative; for we have now and then such dry seasons that the vine produces only small crops, although it will live. By irrigation we can add every necessary to an abundant crop, for water, too, adds fertility, and we have the evidence here in our county of the grape vine one hundred years old, yet as vigorous and prolific a bearer as can be found at any younger age. It is contended by many that water adds to the fertility of the soil (for irrigable soils demand no adding of manure) by reason of the sediment which it carries.

This is undoubtedly true in some localities, like the Nile, where floods run over fertile bottoms, gathering richness from the rich soils that they pass over. So, too, of the Mississippi and other streams of fertile surroundings, but here our washes come from the sterile mountains and beds of dry sand, and they cannot add fertilizers by depositing that which has no fertility. Clear well and spring water are fertilizers, for it is proven that they contain, as they necessarily must, all the mineral and salt substances which are in the soil or rock by which they are surrounded, for water dissolves all these substances; whereas rain, being the product of evaporation, pure water, is entirely free from lime, potash, magnesia, etc., and can only gather a small percentage of these substances in its hurried motion and contact with the soil. That well water has all the necessary elements of plant life has been proven by maize, wheat and oats having been grown by using well water, often renewed, instead of soil for their roots, and these plants fulfilled every stage of development from sprouting, growing leaves and stocks and a normal quantity of seed or grain. To give a detailed description of this water culture would occupy too much space.

Soil is a mechanical necessity to a plant, to hold it in a fixed, upright condition. It is also a storehouse for its ash and salt ingredients. Spring and well water can supply all deficiencies, if any are in the soil, by what it has in solution, and, too, by its solvent power. Irrigation can be excessive. It can make the grape watery, insipid and inferior for wine. Winter irrigation will probably give us every benefit that water can give, and there are very few places but what could have winter irrigation. As my neighbor, Gen. Stoneman, says, "Use your land for your reservoir." It will cost nothing in the making. It is your bank, which will honor the draft of the vine when summer comes, as it is needed.

I have shown, from ten years' experience, that my vineyard, which has never been irrigated, has yielded grapes all that time in paying quantities. It is yet healthy and productive. It is equally sure, to my mind, that with winter irrigation it would have yielded larger crops; and who can say when the time may come that by reason of some element of the grape vine being exhausted it will not go into a decline, and how long that time may be. Such is the case in some vineyards in Sonoma, and replanting is becoming necessary. It is believed by many that they have there the phylloxera, while others believe that the dead and diseased portion of some of their vines is simply the result of the wearing out of the soil, of the exhaustion of some necessary element of vine life. It is said, too, that the phylloxera does not exist where irrigation is practiced.

That for the first years of the growth of a vineyard irrigation

is of no utility, only being additional labor, I feel sure; but that, when producing large crops, irrigation is a great advantage, is equally certain. There are some compensations and uncertainties about this whole subject, however. Irrigation makes much work, and a smaller crop may pay better than a larger one. The quality of the grapes may be better in the case of vines not irrigated; and, by reason of our lands being more fertile in grapevine food than Sonoma non-irrigated vine lands, and being rich in potash, they may not wear out, but continue healthy and vigorous for many years.

### DIFFERENCE OF OPINION.

Col. M. Keller one day on our streets pleasantly said to the writer: "It is well enough for you, who have a business, to make all the different kinds of wine for your sales, but the Mission vine is good enough for the general grower, because this is a country where we can make wines of generous strength, and sweet wines and brandies, and the Mission has no superior for that purpose." I very highly value Col. Keller's opinion, and I have learned much at various times, when conversing with him, on almost every subject; but on this grape question there are some differences between us. It may be owing to the fact that my experiments have been exceptional in getting, perhaps, varieties which he did not; or it may possibly have been in locality; at any rate I have got some few varieties of grapes which, take them all in all, are more profitable to the producer than the Mission, if for no other reason than this, that they produce at least fifty per cent. more grapes to the acre. I think, also, that they are more valuable for other reasons. The Mission grape is one which possesses many good qualities, and is, perhaps, better than nine-tenths of the so-called foreign grapes; for it is found, after years of trial, that out of one hundred varieties there is, perhaps, only one worthy of cultivation, but this last may have qualities for special wines which the Mission does not have. Were there an unlimited demand for angelica and port, then, perhaps, nothing further would be wanted than the Mission grape. It, too, makes a fine brandy; yet I believe a better angelica, port or brandy can be made from other grapes than the Mission. In these three products, as I said before, the Mission excels, and leaves little to be desired; but the demand for these articles is limited, and nine-tenths — yes, ninety-nine hundredths — of the wines drank are dry wines, claret and hocks. Now, the Mission grape dry wines are very inferior, and will not sell for more than half as much, with slow sales, as Zinfandel, Blaue Elba, Berger, Reisling, Gutedel and other wines made from foreign grapes. If this is so, then the only question remaining is, can we produce these grapes? I can with certainty say, yes.

## PROOF OF THE PUDDING.

I have made both red and white wine from foreign and Mission grapes, and Blaue Elba, Zinfandel and Berger will make at least fifty per cent. more wine to the acre than the Mission grape; and in our trade in New York, Chicago and Boston the wines made from the former grapes have brought, to draw it mild, at least twice the price per gallon. Now this is the real test—the money test—and there is no going behind that. Besides this, the wines made from these foreign grapes keep sound much better, with less care, and stand transportation better. It is almost an impossibility to keep a Mission grape red wine to three years old and not have it get sour.

If we had a specialty in wines, which we have not, and unlimited demand for that specialty, then it might do to confine ourselves to that; but it would be "all our eggs in one basket again." If, however, we can make all kinds of wine, or even many kinds of wine, of good quality, it will be still better. We now have a reputation for our sweet wines; but go into the markets where wines are bought in quantities and say, "I have some hock or claret," then you will be asked where you are from, and when told Los Angeles, you will be met by, "Why, you can't make good dry light wines there; Napa and Sonoma are the places to buy those." The only reason for this idea arises from the fact that Sonoma and Napa were settled largely by Germans and other foreigners, who planted foreign vines, Colonel Haraszthy doing much to furnish them, and, consequently, they made a light sub-acid wine, while here we were on the outskirts of immigration, where we found old Missions and old vineyards with but one variety of the grape, viz., the Mission. This grape had apparently every good quality, for was it not the best eating grape we had ever tasted? As it was so rich and so luscious to the taste, did it not follow that it would make the best wine? This was my belief for a time, and when I saw and tasted the Zinfandel I could not for a moment believe it the equal of the mission. But some one suggested that the best cider was made from crab-apples, and not the best eating apple. There are those who contend that this climate is too warm to make a light wine. Let me say to them that you can pick your grapes earlier, pick them before they are overripe, and you will have more tartaric acid and bouquet for your wines. Picking the Mission grapes before they are fully matured makes a better dry wine than picking later. There is something peculiar about the Mission grape when made into a dry wine. It has a peculiar taste and flavor, which is misnamed "ground taste," and the riper and sweeter the grape, the more decided is this taste and smell. It is a misnomer, for the ground has nothing to do with

it, but it is a peculiarity which belongs to the Mission grape and may be called its aroma, if a disagreeable smell can be called an aroma. Why this is so, whether it is because the wine carries so little tartaric acid, or for some other reason, I know not. It is a fact, however, that every variety of grape has some peculiar aroma of its own, in some cases a very pleasant one, and it would seem, in some otherwise.

Now, in making sweet wine there is very little, and often no fermentation at all. Fermentation is stopped, and then we have no earthy taste, and this is why the Mission sweet wine is good. The degree of fermentation can be told with certainty by the presence of more or less of this peculiar smell. All this goes to show that the Mission grape is not adapted to the making of fine light dry wines.

That we can make a fine light dry wine, the equal of that of Sonoma or any other place, is to me a certainty, for I have sold it side by side with their products. I have had critical comparisons with theirs among themselves, and came off, by their own admission, with honors even.

It is with much hesitation that I write this letter. In fact, the oftener I put it off the less positive I become of my facts. It will always be well for the reader to remember that what I have said, and what follows, is true and proven only in this locality; and grapes that would be of the best quality for wine-making and healthfulness on the dry uplands, like those of my locality, may be entirely different, rot and mildew in low and wet localities. With the present demand and short supply, finer qualities will not be appreciated nor paid for, and the Mission grape is well known and tried in all kinds of locations. For me it has less value than other kinds, and I will not plant any more. Yet I do not wish to influence others who have different lands. I give you my experience of nineteen years. These years should teach something for the general good; and could I begin these years again, with my present knowledge, it would be worth several hundred thousand dollars to me. The present outlook for the wine and grape interest is very bright, brighter than at any other period of California's history. Our wines are being recognized as equal to the favored pure productions of any country, and we have a country where much of the land is better adapted to grapes than any other purpose, with a new and virgin soil to begin with; whereas France and Spain, and even Germany are on the decline in production, through the greatest of all pests, the phylloxera, which threatens to exterminate the whole industry, while we are getting ready to take their places. Right here I would most urgently caution all parties from importing grape cuttings from Sonoma or Napa, for the disease is there, and if introduced here it would be the greatest calamity that

could befall this industry. There is a belief by many that the phylloxera can only exist where the soil has been exhausted of some necessary element of fertility to the grape. They find that all reliefs so far have been some substance which is a fertilizer to the vine. The special manure of the grape vine is potash, and this is abundant in all our lands in Los Angeles county. We have only got to look at many of our low lands, where it has been washed from the uplands, to see that there is a super-abundance of alkali.

I will now give you a description of some few varieties of grapes which I have grown for some years, and which have special adaptabilities for special kinds of wine, all being heavy producers. They will, too, bear younger than the Mission, and ripening early, they lengthen out the season for wine making, which is an item of much importance in itself.

BLAUE ELBA.

Bunches medium length and size, shouldered and about as compact as the Mission. Berries round, inclined in some specimens to oval. Skin thin, dark purple, with heavy bloom. Juice sub-acid and pleasant, and a piquant flavored table grape.

It is a vigorous grower, and the young wood has a very clean, pleasing, red look, which distinguishes it even at a distance. It is a regular and heavy bearer, free from all diseases, and standing drouth remarkably well. It makes a white wine of some body, perhaps in that respect similar to the Reisling, but carries too much tartar, and is much like the celebrated Hock "Liebfrauenmilch" of the Germans. It is a white wine of the highest bouquet and quality, and is admired and is a favorite with every white wine drinker. It is pronounced the equal, by all German connoisseurs, of the better qualities of Rhine wine, and it is believed by many of these that, if shipped to Germany, it would command a sufficient price to pay for producing and shipping. It will, too, make a brandy of the highest bouquet.

This grape was introduced by Jacob Keller (now dead), of Anaheim, who brought it from Germany. He gave me a small lot of cuttings, which from year to year I increased, until now it is the leading variety in my vineyard. It has, too, been tried for some years in my neighborhood, and all who have planted it join in its praise for thrift and productiveness.

It makes a red press wine, which, however, is inferior, yet which is better than the Mission red wine. Since Mr. Keller's death this grape has been lost sight of and is scarcely known there.

ZINFANDEL.

Bunches generally nearly equally divided in two long shoulders, making a medium size cluster, with the berries so compact

that it forms a stiff cluster of grapes. Berries medium size, round, black, with much bloom, quite acid and unfit for table use, but it is probably the most popular wine grape now in this State, especially for a light table wine. It is a thrifty grower, yet never makes a large stem, and is a very heavy bearer. It belongs to the Pinean family, and was introduced by the late Col. Haraszthy from Hungary.

It makes a light wine, picked when not overripe, both white and red, with the highest bouquet. The white wine is much used in the manufacture of the best champagne, and the red wine has as yet no equal in this State; and, take it as a general wine, made in large quantities without fancy manipulations or regard to special locality, it has perhaps no superior anywhere.

### BERGER.

Bunches long, large, shouldered and very compact; berries round, fair size, skin thin, greenish yellow, with some bloom. Juice acid and the poorest table grapes as yet tried by me of all the foreign grapes. It is a vigorous grower, and the leaves are large with a white cotton down on the under side. I believe it to be the heaviest bearer of all the grapes, and think it doubles the production of the Mission. It is, however, a matter of doubt with me whether it would do on low localities, for, the bunches being so compact, in wet places it would be almost sure to rot and mildew. It makes, to my mind, the most pleasant light table wine in California, being more of the character of German Sauterne than any other wine. This wine is used one-third and two-thirds Zinfandel, to make the best of Haraszthy's champagne. I believe it especially adapted for this county, for our table-lands. It was introduced to Anaheim from Germany, and Berger is the German name. I am inclined to the belief that it is the same grape as that known in France as Fole Blanche, for it is identical with the description of that grape there. The Fole Blanche is used in France almost entirely as a brandy grape, making the celebrated cognacs. It has too much acidity there, and makes, in consequence, an inferior wine, whereas with our perpetual sunshine the grape attains a fuller maturity, and makes a wine that for a light wine for daily drinking has no equal, to my taste. This shows that we can only find by experimenting what grape is best for our locality, for what may be worthless in a wet, cold locality, in our dry and warm climate will give entirely different results.

### BURGUNDY.

General Naglee, of San Jose, introduced from France the Charbonneux and Trousseau. These are mixed together and both belong to the Pinean family of grapes. Here in California

they have acquired the general name of Burgundy, probably from the fact that they came from that district, and are used to make that celebrated wine. The two varieties of grapes are so much alike in wood, foliage and fruit, that I for a long time believed them to be one variety, until some years ago the bees taught me the difference between them, for they would make their attack on one vine and another vine by its side they would not touch. I then found, by tasting, one much sweeter than the other. The grapes of either are small, very black, small bunches; the leaf but little lobed or serrated, and round, much like some of our wild grapes grown in this neighborhood. It has a great many bunches and is a heavy bearer. Gen. Naglee assured me that the year I was there they had averaged thirty-three pounds to the vine, and it is from this grape that he makes his best brandy. He also told me it made a very superior black (he named it) wine. I have not tried it sufficiently here to speak with certainty about the quality of the wine, but I know it is a heavy bearer and believe it will make the best heavy red wine (Burgundy) in the State. As yet it is not generally introduced in this State, it being confined to San Jose and Santa Clara county, but such wine as has reached the San Francisco market has been pronounced the best red wine in the State. I have not had it long enough, or in sufficient quantity to make wine from it, except in an experimental way. I believe in it. It is a fair eating grape.

I could add Muscat of Alexandria, which, I am inclined to think, will make a very popular brandy, and West St. Peter's, which is said to be the best sherry grape as yet tried in California.

# BUSINESS MENTION.

BUSINESS ANNOUNCEMENTS of the following enterprising firms appear in the Advertising Department of "ORANGE CULTURE IN CALIFORNIA." They will be found in the order herein named:

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DALTON & GRAY, Commission Merchants. Produce, Grain, Wool, Hides, Fruits, Etc. 404 and 406 Davis St., San Francisco. – 231.

WOODHEAD & GAY, Wholesale Dealers in California Fruits, Nuts, Honey, Trees, Plants and Seeds, 40 and 42 Spring St., Los Angeles, Cal – 232.

THE QUEEN, Fashionable Boot and Shoe Store, 104 Main St., Los Angeles,. – 232.

E T. WRIGHT, County Surveyor, Room 3, Downey Block, Los Angeles, Cal.—232.

J. A VALDER, Dealer in Pictures, Frames, Window Cornices, Artists' Materials, Etc. No. 42 Spring St., Los Angeles, Cal.—232.

PRESS AND HORTICULTURIST, a Weekly Newspaper, published by L. M. Holt, at Riverside, Cal.—233.

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